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NATURAL ANTIOXIDANTS AND ITS BENEFITS

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Abstract

The consumer concern regarding the safety of using synthetic antioxidants in convenient food products has forced and motivated the food processors to seek for natural alternatives. This leads to a situation where the application of synthetic antioxidants started to decrease drastically in food products. Hence there has been a increasing global trend towards the use of natural antioxidants present in fruits and green leafy vegetables. The effects of these natural antioxidants in scavenging the free radicals are well discussed and reported in the earlier studies. The factors that encourage the use of natural antioxidants are its low cost, compatibility with diet and less harmful effect in the human body. The strong H-donating capacities of various phytochemicals make them as a effective natural antioxidants. Phenols present in plant extracts acts as a potential antioxidant by inhibiting the free radical formation and also prevent auto oxidation. Phenolic acids, flavonoids and volatile oils possess higher antioxidant activity and also acts as the essential part of diet and this claims were supported by various scientific evidence. The health promoting capacity of these natural antioxidants help in eradicating chronic diseases such as cancer. Hence in this review the action of antioxidants on free radicals, occurrence, classification and potential health effects of natural antioxidants was discussed.

Keywords: Natural foods; antioxidants; chronic diseases; cancer; phytochemical; phenols.

INTRODUCTION

It is unbelievable that oxygen, which is an indispensable element for life, under certain situations have severe deleterious effects on the human body. The negative effects of oxygen are due to the formation and activity of number of chemical compounds, known as reactive oxygen species (ROS). Reactive oxygen species is a collective term that includes all reactive forms of oxygen, including both oxygen radicals and several non radical oxidizing agents that participate in the initiation and/or propagation of chain reaction (Shivkumar, 2011). Many such reactive species are free radicals that represent a class of highly reactive intermediate chemical entities whose reactivity is derived from the presence of unpaired electron in their structure. It is capable of independent existence for very brief interval of time. It was found that a wide variety of oxygen free radicals and other reactive species are formed in the human body and food system (Cui *et.al.*, 2004). It was known that the quality of food was attributed to various factors such taste, aroma, and appearance. The convenient foods which meets this attributes has led to the rapid growth in ready-to-eat product category (Hofstrand, 2008). Many of such foods contains ingredients that increases the nutritive value, palatability and one of its kind was the polyunsaturated fatty acids (PUFA) such as omega 3, omega 6 fatty acids and the beneficial activity of which was well studied (Simopoulos et.al., 1999; Ruxton et.al., 2004; Stephensen, 2004). Despite its higher nutritional value in foods, this bioactive component is very much susceptible to quality deterioration, especially under oxidative stress and gradually forms free radicals. The action of free radicals can, however, is blocked by antioxidant substances which scavenge the free radicals and detoxify the organism. The effort to reduce the free radical oxidation in food matrix has increased by the addition of potential antioxidants, below the consumable limit (Hillmann, 2010). The use of plant extracts as natural antioxidants has received increased interest due to the concerns on negative health effects developed by the use of synthetic antioxidants (Abramovic and Abram, 2006; Kowalski, 2007; Azizkhani and Zandi, 2009). Synthetic antioxidants such as butylated hydroxytoluene (BHT) and butylated hydroxyanisole (BHA) are highly volatile and instable at elevated temperature. The strict legislation on the use of synthetic food additives, carcinogenic nature of some synthetic antioxidants, and consumer preferences have shifted the attention of manufacturers from synthetic to natural antioxidants. Most of these natural antioxidants come from fruits, vegetables, spices, grains, and herbs. Also, due to toxicological concerns of synthetic antioxidants (Nakatani, 2000), phenolic compounds in plants were used to minimize or retard lipid oxidation in lipid-based food products. Fruits, vegetables and medicinal herbs are the richest sources of antioxidant compounds such as Vitamin A, C, E, betacarotene and important minerals (Sies et.al., 1992). In addition, the call for sustainable source and also the environmentally friendly production is forcing the food industry to move in that direction (Berger, 2009).

OXIDATION

The utilization of oxygen to produce energy through the metabolism of food nutrients acts as a prerequisite for the survival of all living beings. While oxygen is one of the most essential components for living, it is also a highly reactive atom that is capable of becoming part of potentially damaging molecules such as hydroperoxyl radicals, superoxide anions, singlet oxygen, hydrogen peroxide, organic peroxides, nitric oxide, peroxynitrite and triplet oxygen. Oxygen uptake while breathing causes free radical production and in addition to that environmental factors such as pollutants, smoke and certain chemicals also contribute to their formation (Fig-1). In turn, these radicals can start chain reactions in cells and it can cause damage or death to the cell (Srinivasan et.al., 2008). This process also takes place in food matrix that contain higher amount of lipids and affects its stability. The components that have the antioxidant property were intentionally added in lipid foods to terminate the chain reactions by removing free radical intermediates and inhibit other oxidation reaction. Antioxidants normally neutralize the free radicals by being oxidized themselves and act as reducing agents such as thiols, ascorbic acid, or polyphenols. In the case of long storage of foods such as ready to eat foods or processed foods, additional antioxidant source must be added below the consumable limit of human consumption to restrict the formation of free radicals and keep the food safe.

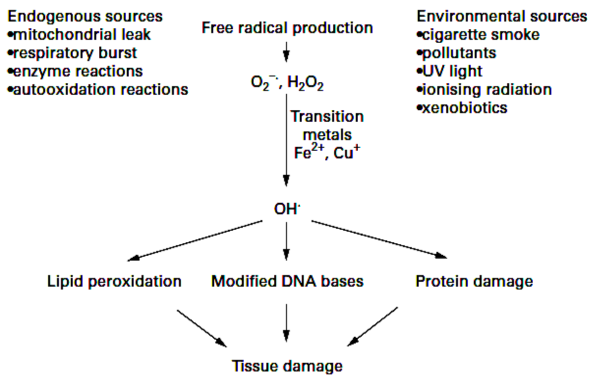


Figure 1- Sources of free radicals and its consequences in human body

FREE RADICAL

A free radical can be defined as, "any molecular species capable of independent existence that contains an unpaired electron in an atomic orbital and capture electrons from other substances in order to neutralize themselves" (Halliwell and Gutteridge, 1999). The existence of an unpaired electron results in certain common properties shared by most of the radicals (Lobo et.al., 2010). The free radical has the ability of donating or accepting an electron from other molecules (Cheeseman and Slater, 1993). This will stabilizes the free radical at the beginning but starts to produces another in the process. Soon a chain reaction begins and thousands of free radical reactions can occur within a few seconds on the primary reaction (Shivkumar, 2011) (Fig-2). These reactive species are capable of causing damage to the vital biological molecules such as such as DNA, proteins, carbohydrates, and lipids (Young and Woodside, 2001) and resulted in a homeostatic disruption.

Free radicals can be formed by three ways -

a. Homolytic cleavage of covalent bond of normal molecule, with each fragment retaining one of paired electrons.

$$X:Y \longrightarrow X^{\bullet} + Y^{\bullet}$$

b. Loss of single electron from normal molecule.

$$X:Y \longrightarrow X^{-} + Y^{\cdot}$$

c. Addition of single electron to normal molecule.

$$X + e^{-} \longrightarrow X^{\cdot}$$

Figure 2. Mechanism for the formation of free radicals

FREE RADICAL BIOLOGY

The formation of free radicals occurs in the human body as a consequence of enzymatic and non enzymatic reactions. Enzymatic reactions, which serve as source of free radicals, include those involved in the respiratory chain, phagocytosis, prostaglandin synthesis, and in the cytochrome P-450 system (Liu et.al., 1999). The free radicals attack the healthy cells of the body and lead to damage, disease and severe disorders. Cell damage caused by free radicals appears to be a major contributor to aging and disease (Harman, 1992) like cancer, heart disease, decline in brain function and immune system. Plants and animals maintain complex systems of multiple types of antioxidants in order to prevent themselves from these damages. Insufficient levels of antioxidants or inhibition of the antioxidant enzymes cause oxidative stress and may damage or kill cells. When this condition prevail, the ROS molecule at higher concentration causes damage to cell structures, nucleic acids, lipids and proteins (Valko et. al., 2007). $O2^{\bullet -}$ radical is responsible for lipid peroxidation and also reduce the activity of enzyme antioxidant defence system such as catalase (CAT) and glutathione peroxide (GPx). $HO2^{\bullet}$, which is a protonated form of $O2^{\bullet -}$ is more reactive and able to cross the membrane and causes damage to tissue. $OH^{\bullet}$ radical is most reactive chemical species and potent cytotoxic agent which attack and cause damage to every molecule found in living tissue. HOCl initiates the deactivation of antiproteases and activation of latent proteases leading to tissue damage. It has ability to damage biomolecules and also decomposes to liberate toxic chlorine. Metal induced generation of ROS attack DNA and other cellular components involving polyunsaturated fatty acid residues of phospholipids, which are extremely sensitive to oxidation. A Peroxyl radical causes damage after rearranged via a cyclisation reaction to endoperoxides. Studies show that free radicals produce oxidation of the side chains of all amino acid residues of proteins, particularly cysteine and methionine (Valko et.al., 2007).

ANTIOXIDANTS

Antioxidants are compounds of many different chemical forms, grouped together because they all have the property of counteracting the effects of highly reactive, harmful free radicals formed as the result of essential oxidation reactions which normally takes place in food. The possible mechanisms of action of antioxidants were first explored when it was recognized that a substance with anti-oxidative activity is likely to be the one that itself readily oxidized. An antioxidant can be defined as: "any substance that, when present in low concentrations compared to that of an oxidisable substrate, delays or inhibits the oxidation of that substrate" (Murthy, 2001). Earlier the research on the role of antioxidants in biology focused on its use in preventing the oxidation of unsaturated fats, which is the cause of rancidity (German, 1999). Many evidences from researches have demonstrated that many natural products isolated from plant sources possess antitumor properties (Wu et.al., 2002). A variety of free radical scavenging antioxidants is found in dietary source like fruits, vegetables, tea, etc., (Mandal et.al., 2009). Most importantly fruits can add important vitamins, minerals, and other bioactive compounds to the human diet (Vasco et.al., 2008). The important commercially available natural antioxidants are tocopherols (vitamin E), ascorbic acid (vitamin C) and rosemary extract (Löliger, 1991; Trombino et.al., 2004). Several natural phenolic compounds have been reported to possess high antioxidant properties, but only a few of them are found to be commercially applied in foods. The main lipid-soluble antioxidants currently used in food are monohydric or polyhydric phenols with various ring substitutions. For maximum efficiency, primary antioxidants are often used in combination with other phenolic antioxidants or with various metal sequestering agents, e.g. tocopherols with citric acid and isopropyl citrate. The antioxidants obtained from plants are more functional towards improving the shelf life of food products and providing health promotion when compared to materials whose antioxidants have been removed during processing. Compounds such as β-carotene, ascorbic acids have demonstrated to have antioxidant and synergistic activity in despite of their non-phenolic structure (Hudson and Mahgoub, 2006; Trombino et.al., 2004).

CLASSIFICATION OF ANTIOXIDANTS

The endogenous antioxidants are produced by body to neutralize the free radicals and protect the body from different disease. The endogenous antioxidant defence systems classified into two groups such as enzymatic and non enzymatic. Antioxidants that are externally supplied to the body through food are said to be exogenous antioxidants which plays important role to protect the body. While there are dozens of known antioxidants, two are absolutely indispensable, vitamins E and C. These vitamins are partners in defence and they have a synergistic relationship working together so that their combined effect is greater than the sum of their individual actions.

NATURAL ANTIOXIDANTS

Natural antioxidants are synthesised by plants (e.g. Vitamins and other naturally-occurring chemicals in our food) and are present in the foods we eat, as opposed to those synthetic antioxidants that are either added to food to extend its shelf-life (e.g. BHT). Natural antioxidants are found in most fresh food, for e.g. When a cut apple turns brown, that is through oxidation and the application of lemon juice over the surface will slow the process. These antioxidants are of high or low molecular weight, can differ in their composition, their physical and chemical properties and in their mechanism and site of action. They can be divided into following categories:

ENZYMES

Enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase attenuate the generation of reactive oxygen species (ROS) by removing potential oxidants or by transforming ROS/RNS into relatively stable compounds. Superoxide dismutase is an important endogenous antioxidant enzyme act as the first line defence system against reactive oxygen species. It catalyzes the transformation of the superoxide radical into hydrogen peroxide, which can then be further transformed by the enzyme catalase into water and molecular oxygen. While superoxide anion in itself is not particularly reactive, it can reduce transition metal ions, such as iron, and it is converted to one of the most reactive radicals such as the hydroxyl radical. Thus, elimination of superoxide can attenuate the formation of the harmful hydroxyl radical (Harris, 1992). Glutathione peroxidase (GPx) reduces lipid peroxides (ROOH), formed by the oxidation of polyunsaturated fatty acid (PUFA), to a stable, non-toxic molecule-hydroxyl fatty acid (ROH). Together with phospholipases GPx can also convert phospholipid hydroperoxides (PL-OOH) into phospholipid hydroxide (PL-OH) (Jacob, 1995). GPx present in the cytoplasm of the cells removes H_2O_2 by coupling its reduction to H_2O with oxidation of GSH.

HIGH MOLECULAR WEIGHT PROTEINS

Proteins such as albumin, ceruloplasmin, transferrin and haptoglobin, which are all present in plasma, bind to redox active metals and limit the production of metal-catalyzed free radicals. Albumin and ceruloplasmin can bind copper ions, and transferrin binds free iron. Haptoglobin binds heme-containing proteins and can thus clear them from the circulation. Both free and heme-associated proteins have pro-oxidant properties due to their reaction with H_2O_2 to form ferryl species which can easily initiate lipid peroxidation.

LOW MOLECULAR WEIGHT ANTIOXIDANTS

These antioxidants are subdivided into lipid-soluble antioxidants such as tocopherol, carotenoids, quinones, bilirubin, etc., and water-soluble antioxidants such as ascorbic acid, uric acid and other polyphenols. They delay or inhibit cellular damage mainly through their free radical scavenging property. Tocopherols and tocotrienols are the most important lipid-soluble antioxidants present in vegetable oils (Holownia et.al., 2001). Tocopherols and tocotrienols share the same ring structure (Fig-3), the only difference being tocotrienols have the unsaturated carbon chains. Tocopherols present in crude vegetable oils survives the oil processing steps and remains in sufficient quantities to provide oxidative stability in the finished products. Tocopherols interrupt free radical chain reaction by capturing free radicals generated during oil auto oxidation. At high concentration, tocopherols acts as a prooxidants (Angelo, 1996) and it was found, at higher concentrations α-tocopherol (200-2000ppm) may participate in two side reactions such as a) Decomposition of hydroperoxides, b) Spontaneous oxidation. The optimum tocopherol concentration to inhibit peroxide formation should be established for a well defined system.

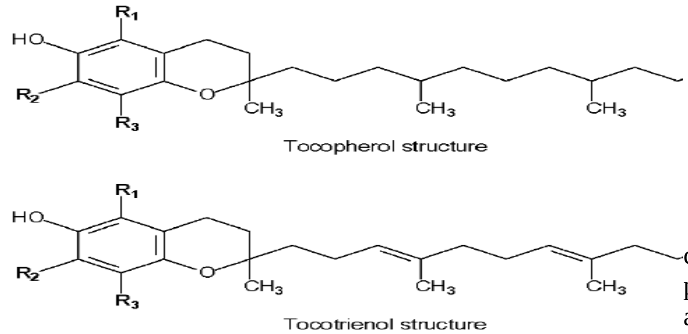


Figure 3- Low molecular weight antioxidants

PLANTS DERIVED ANTIOXIDANTS

The dietary phytochemical antioxidants have the ability to remove free radicals and it was revealed by various animal studies. Phenolics are large and heterogeneous groups of secondary plant metabolites that are distributed throughout the plant kingdom. Compounds that have several or many phenolic hydroxyl substituents are often referred to as polyphenols.

There are hundreds of natural phenolic compounds have been reported to possess high antioxidant property. However their use in foods is limited by certain requirements due to inadequate proof of safety. To achieve the maximum efficiency certain primary antioxidants such as tocopherols are used in combination with citric acid or isopropyl citrate. It was reported that phenolic antioxidants (PhH) can react with ROO• to generate ROOH and a relatively unreactive phenoxyl radical (Ph•).

$$ROO\cdot + PhH \longrightarrow ROOH + Ph\cdot$$

Ph· can subsequently undergo chain termination reactions with ROO• to give non-radical products (Hashim et.al., 1993).

$$ROO\cdot + Ph\cdot \longrightarrow \text{Non radical products}$$

Thereby the phenolic substances acts as a chain-breaking antioxidants by competing with the substrate (RH) for the chain carrying peroxyl radicals. Vanillic, caffeic, sinapic and coumaric acids are relatively ubiquitous monohydroxylated phenolic acids whose antioxidant capacities have been demonstrated (Taruscio et.al., 2004). Some phenolic acids have the metal chelating potential. Various berry items such as blueberry, mulberry, strawberry, cloudberry and raspberry possess high contents of hydroxy cinnamic acids, ellagic acid, ferulic acid and various derivatives (Zadernowski et.al., 2005; Häkkinen et.al., 1999) (Fig-4).

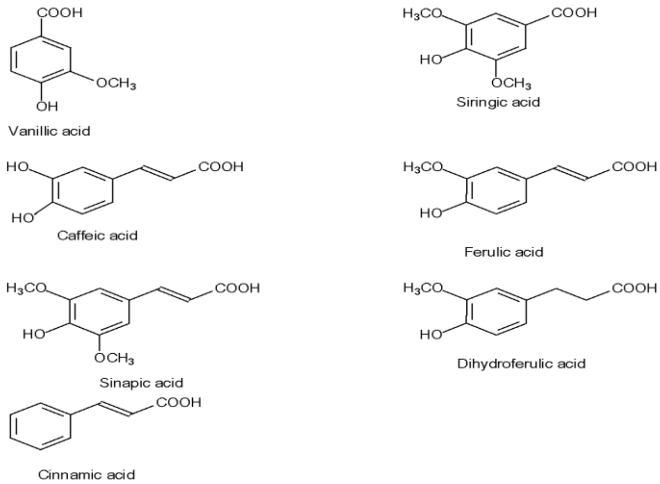


Figure 4- Structure of various phenolic acids

Some other berries such as bilberries, black currents, cranberries displayed stronger antioxidative properties, an especially bilberry was found to contain high amount of hydroxycinnamic acid. The extract of different berries such as crowberry, rowanberry, cloudberry, cranberry, and whortleberry were found to inhibit the formation of MeLo - conjugated diene hydroperoxides by 90%. The phenolic compounds present in the olive oils has been analysed and the amount of phenolics depend on variety, fruit maturity and the environmental conditions (Torres et.al., 2005). The phenolics in the olive fruits are characterized by the number of secoiridoid compounds derived from p-hydroxyphenylethanol (tyrosol) and 3,4-dihydroxyphenyletahnol (hydroxytyrosol) (Fig-5).

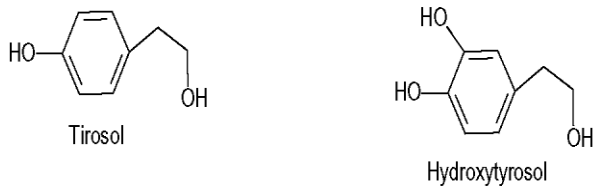
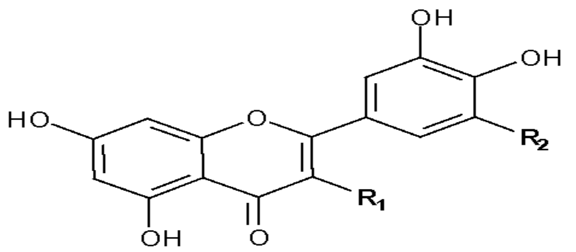


Figure 5- Structure of tyrosol and hydroxytyrosol

Flavonoids and tannins are the main phenolic compounds (Rababah et.al., 2005). Flavonoids are the natural polyhydroxylated aromatic compounds vastly present in the plant system including fruits and vegetables. The polyphenolic compounds, such as flavonoids and catechin present in edible plants, exhibit potent antioxidant activities and it was reported in the earlier studies (Fang et.al., 2002). It constitutes about 2/3 of the polyphenols that we obtain in our diet. On an average human consume 1g/day of flavonoids and it was estimated (Das and Ramanathan, 1992). The efficiency of different flavonoids depends on the structure and their relationship was investigated (Bors et.al., 1992) (Fig-6).



Flavonoids	R1	R2
Luteolin	H	H
Myricetin	OH	OH
Quercetin	OH	H
Isoquercitrin	*O*-glucose	H
Rutin	*O*-glucose	H
Myricitrin	*O*-rhamnose	OH

Figure 6-Structure of flavonoids and its derivatives based on R1 and R2 substitutions

They scavenge the reactive free radicals, including hydroxyl, peroxyl and superoxide radicals (Hopia and Heinonen, 1999) and to deactivate catalytic metals due to complexation (Afanasèv *et.al.,* 2000). They also inhibit the activity of lipoxygenase and cyclooxygenase enzymes and its increase in blood plasma decreased the level of LDL cholesterol oxidation (Torres *et.al.,* 2005). The carotenoid, such as carotene and cryptoxanthin of plant origins, exerts potential antioxidant effect on oil rich food systems (Aruoma, 1998). For example, carotene reacts with a peroxyl radical to form a resonance-stabilized carbon-centered radical, thereby inhibiting the chain propagation effect of ROS. It was reported that lycopene, lutein, canthaxanthin, and zeaxanthin possess antioxidant action similar to, or even greater than, those of carotene (Aruoma, 1998). It was found, a diet rich in brussels sprouts (300 g/d) markedly decreases the urinary excretion of 8-hydroxydeoxyguanosine in humans, indicating a reduction of DNA oxidation (Lei, 2002). Similarly, dietary supplementation of cabbage and broccoli extracts to rats decreases free radical-induced tissue damage brought about by irradiation. Moreover, phytic acid has a high chelation potential and can be supplemented to diets for suppressing iron-catalyzed oxidative reactions and potentially for reducing the incidence of colonic cancer and inflammatory bowel disease (Graf and Eaton, 1990). Collectively, these studies suggest that phytochemical may be used as effective antioxidants for improving human health and preventing carcinogenesis and cardiovascular disease.

SYNTHETIC ANTIOXIDANTS

Synthetic antioxidants are widely used as food additives to prevent rancidification, owing to their high performance and wide availability. Synthetic antioxidants such as butylated hydroxyanisole (BHA), tertiary butyl hydroquinone (TBHQ), 2,4,5-trihydroxybutyrophenone (THBP), propyl gallate (PG), octyl gallate (OG), nordihydroguaiaretic acid (NDGA) and 4-hexylresorcinol (4HR) are used in edible vegetable oil and cosmetics (Guan et.al., 2005; Nazni et.al., 2013;Guo et.al., 2006). Propyl gallate and butylated hydroxyanisole, as synthetic phenolic antioxidants, had a higher chemical activity for suppressing chain initiation of the oxidation of unsaturated fatty acids. Although they are powerful in protecting product quality in food distribution, excess antioxidants added to food might produce toxicities or mutagenicities, and thus endanger the health of people. Based on the type of fat and oil in food, antioxidant will be chosen. BHA and BHT dissolves in most fats and oils and best suited to animal fats. When used as a combination in foods, it imparts a beneficial effect rather than using it alone. In contrast, propyl gallate which is not readily soluble, is more effective in vegetable oils than are BHA and BHT. TBHQ is the most effective antioxidant for retarding oxidation in unsaturated fats like vegetable oils. Oxidative stability can be achieved with lower levels of TBHQ than that of other synthetic antioxidants (Fig-7).

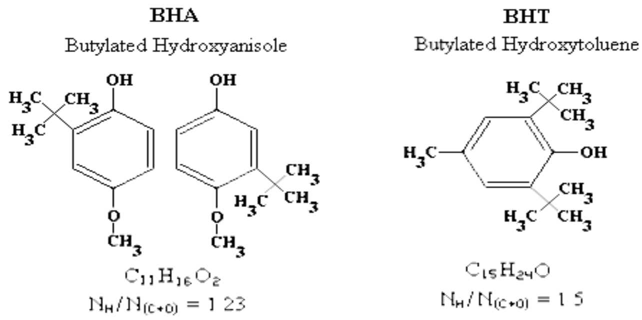


Figure 7- Structure of Butylated Hydroxy Toluene and Butylated Hydroxy Anisole

NATURAL AND SYNTHETIC ANTIOXIDANTS

Antioxidants such as natural and synthetic, are used by the food industry as food additives to help prolong the shelf life and appearance of many foodstuffs. Synthetic phenolic antioxidants (butylated hydroxyanisole [BHA], butylated hydroxytoluene [BHT], and propyl gallate) effectively inhibit oxidation, for e.g.: chelating agents such as ethylene diamine tetra acetic acid (EDTA), can bind metals reducing their contribution to the process. Antioxidants also occur naturally in many foods and are essential for our health. They include Vitamin C found in fruit and vegetables and vitamin E found in seeds and nuts. Some vitamins (ascorbic acid and α-tocopherol), many herbs and spices (rosemary, thyme, oregano, sage, basil, pepper, clove, cinnamon, and nutmeg), and plant extracts (tea and grapeseed) contain antioxidant components as well. While use of synthetic antioxidants (such as butylated hydroxytoluene and butylated hydroxyanisole) to maintain the quality of ready-to-eat food products has become commonplace, consumer concern regarding their safety has motivated the food industry to seek natural antioxidants. The antioxidants that have caused health problems, for some people, are primarily synthetic. The most problematic antioxidants appear to be BHA, BHT and TBHQ, with gallates in second place and have been used in food products, with some restrictions, since the late 1950s. TBHQ is a more recent addition to the list of antioxidants allowed in food, in Europe, it became an accepted antioxidant for food use in 2004. BHA, BHT, and TBHQ are used in a variety of products but are most commonly found in foods that contain oil and fat. Their action is similar to that of Vitamin E which is used in some of the same type of products as an alternative antioxidant. These antioxidants sometimes appear alone in a food but are often used in combination with other chemicals that also have an antioxidant activity including propyl gallate, citric acid, phosphoric acid, and ascorbic acid.

HEALTH CONCERNS OF SYNTHETIC ANTIOXIDANTS

Whilst the majority of studies have been carried out on animals, there is still quite a large body of research that has identified problems with these synthetic antioxidants for humans. The table (Table-1) below lists some of the health problems in humans that have been linked with adverse reactions to BHA, BHT and/or TBHQ.

Table 1- Adverse reactions to BHA, BHT and/or TBHQ

Asthma	Joint pains
Angioedema	Rhinitis
Dermatitis	Undescended testes
Stomach problems	Vasculitis
Eye problems	Obesity
Excessive sweating	Urticaria

In a study involves seven individuals with reactions to BHA and BHT reported with symptoms included vasomotor rhinitis, headache, flushing, asthma, conjunctival suffusion, dull retrosternal (behind the breastbone) pain radiating to the back, diaphoresis (excessive sweating), or somnolence (sleepiness). In a later study, identifying cross reactivity with aspirin, they found twenty-one people intolerant to BHA and BHT. These synthetic antioxidants have been found to cause dermatitis in a number of people (Le Coz and Schneider, 1987). In one study, contact dermatitis was caused by TBHQ in a hair dye and cross sensitization with BHA and BHT was noted**.** The US Department of Health and Human Services states in their report on Carcinogens that BHA is “reasonably anticipated to be a human carcinogen based on sufficient evidence of carcinogenicity in experimental animals”. There is also concern that “BHT may convert to other substances in the human body that may be carcinogenic. For example, one conversion product of BHT (the hydroperoxide form) has been shown to disrupt the chemical signals that are sent from cell to cell.

CONCLUSION

Antioxidants are almost ubiquitous in commonly consumed food products, as they are generally pre-existing compounds in the form of natural antioxidants, or are added during processing as synthetic antioxidants. As natural antioxidants have been shown to have significant benefits in preventing cancer and heart disease, many food advertisers have taken note and begun publicizing this fact. Antioxidant content in foods has achieved prominence on many food labels, ranging from fruit juices to chocolate products. As long as they are consumed in moderate concentrations, natural antioxidants have been proven to have many positive health effects, such as preventing plaque formation in the arteries and preventing other chronic conditions such as cancer and heart disease. These beneficial properties have put natural antioxidants on the forefront of recent food advertising, and public levels of awareness concerning natural antioxidants and their positive effects have increased significantly. Unlike natural antioxidants, however, synthetic antioxidants have been shown to have potential toxic effects on the health of consumers. Additionally, synthetic antioxidants are not advertised prominently on food labels and the number of studies done on public awareness of the synthetic antioxidants and their health effects is sparse, in direct contrast to the focus placed on the natural antioxidant content of food items. This lack of interest and inquest has led synthetic antioxidants to be the subject of few studies, particularly those assessing the public’s awareness of their presence and toxic effects. On the basis of this review following conclusions can be drawn, 1. Free radicals are very harmful to human health and can cause several degenerative diseases like diabetes, cancer, atherosclerosis, hypertension etc. 2. Various kinds of antioxidants particularly from natural sources such as enzymes, tocopherol, carotenoids, ascorbic acid, polyphenols etc. inhibit the cellular damage mainly through free radical scavenging property.

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