academicresearchJournals

Vol. 7(3), pp. 100-109, April 2019
DOI: 10.14662/ARJASR2018.114

ISSN: 2360-7874
http://www.academicresearchjournals.org/ARJASR/Index.htm

Academic Research Journal of Agricultural Science and Research

Full Length Research

Natural Antioxidant and Antimicrobial: Ginger, Garlic, Rosemary and Turmeric

[1]Tamirat Kore and [2]Muhaba Seifu

[1,2]Debrezeit Agricultural Research Center, EIAR, P.O. Box 2003, Addis Ababa, Ethiopia.
Correspondence should be addressed to: E-mail: tamiratkore9@gmail.com

Accepted 21 January 2019

Spices and herbs are good source of natural antioxidants and antimicrobial constituents. Similarly, synthetic antioxidants have the capacity to prevent the oxidation of food products. But currently the consumer safety has great concern on synthetic antioxidants as result increasing the demand of spices and herbs. Garlic, ginger, rosemary and turmeric have been used in many countries for traditional medicine and for sensory attributes (taste, color and aroma) which owned as in a form of whole, ground and aqueous extracts. They have also been used for preservation of fresh and processed food due to their active antioxidant constituent. The oxidation of food product leading to the formation of free radical that implicated undesirable oxidative product. The active ingredients in ginger, garlic, rosemary and turmeric are very powerful because they contain excellent source of active shogoal, phenolic, carnosol and curcumin constituent, respectively. In addition to their effectiveness as antioxidant properties, they grouped as a natural bio-active antimicrobial impact which inhibits the growth of microbes. Thus, the extract of ginger, garlic, rosemary and turmeric used as a means to control oxidation with free radical scavenging characteristics and protect spoilage of food product; which has well-liked and better acceptance from consumers.

Key words: Ginger, Garlic, Rosemary, Turmeric, Natural Antioxidant, Antimicrobial, free radical

Cite this article as: Cite this article as: Tamirat K, Muhaba, S. (2019). Natural Antioxidant and Antimicrobial: Ginger, Garlic, Rosemary and Turmeric. Acad. Res. J. Agri. Sci. Res. 7(3): 100-109

INTRODUCTION

Antioxidants are substances that scavenge free radical which cause oxidation of food product. Oxidative rancidity is a major cause of food quality deterioration and product rejection and can lead to the formation of undesirable off- flavors as well as harmful compounds (Decker et al., 2010). Natural and synthetic antioxidants are responsible for removal of free radicals, scavenging reactive oxygen species (ROS), inhibiting formation of ROS and binding metal ions (Gilgun et al., 2001). Most food processing industry used chemical preservatives for delaying microbial spoilage (Gutierrez et al., 2009) and synthetic antioxidants (butaylatedhydroxyanisole (BHA) and butaylatedhydroxytoluene (BHT)) for retarding lipid oxidation. Both BHT and BHT converting certain ingested materials into toxic substances and carcinogens (Farag et al., 1989). As result synthetic antioxidant may cause health impact in humans and may not contribute additional nutritional benefits (Embuscado, 2015). However, consumers are becoming increasingly health conscious and are demanding natural, wholesome and health-promoting products (Sati et al., 2011). Thus, spices and herbs are an excellent source of natural antioxidant. Two major groups of natural antioxidants such as enzymatic (catalase, glutathione peroxidase and superoxide) and non-enzymatic (ascorbic acid, polyphenols, carotenoids and chelating agents) for purpose of against oxidative stress (OS) and binding to redox metals to prevent free radical generation (Gad and Sayd, 2015).

Spices and herbs are derived from a distinct portion of plants (seed, leaf, flower buds, fruit, bark and rhizome) which owned as fresh and processed form. Herbs come from leaves of a plant while spices from different parts of a plant except leaves. They have providing taste and pungency of food; making food more appetizing and palatable; imparting an attractive color; complex secondary effects such as salt and sugar reduction; improvement of texture and prevention of food spoilage (Marija and Nevena, 2009).

In addition to imparting sensory attribute, they have a major role in antioxidant and antimicrobial properties (by delaying the spoilage of food); functional and health benefit in traditional and modern medicine (Remadevi et al., 2007). Extracting bioactive component from herbs and spices with extracting method owned as infusions, decoctions, macerations, teas, juices, syrups, poultices, oils, ointments and powders (Peter, 2004). These constituents include acids, alkaloids, phenol, steroids anthraquinone, bitter, coumarine, flavones, glycosides, resins, saponins, tannins and volatile oils (De Guzman and Sienonsma, 1999). Furthermore, they impart a natural antimicrobial effect of food for preserving natural spoilage processes and for preventing the growth of microbes (food safety) (Ifesan et al., 2010). Gram-positive bacteria (spore- and non-spore-formers), gram- negative bacteria, yeasts and moulds are all affected by a wide concentration range of essential oils (Ippolito and Nigro, 2003). Therefore, the main objective of this review was to overview the antioxidant and antimicrobial characteristics of commonly used spice and herbs: ginger, garlic, rosemary and turmeric.

Mechanism of Action

Antioxidant provides protection of free radical which formed during the lipid oxidation and rearrange to stable conformation. The main factor which initiate lipid oxidation are oxygen and transitional metals. These catalysts must be removed to minimize the rate of lipid oxidation. Natural antioxidants are compounds which delay autoxidation by inhibiting formation of free radicals using free radical scavenger, chelating metal ions and oxygen scavenger (Nawar,1996).

Antioxidants are classified as primary and secondary. The primary antioxidant is the conversion of free radical chain into stable molecules. The most effective antioxidants interrupt the free radical chain reaction and usually contain aromatic rings capable of donating hydrogen to the free radical formed during lipid oxidation. The formed antioxidant radical is stabilized by delocalization of the unpaired electron around the phenol ring to form a stable resonance hybrid (Gad and Sayd, 2015). Secondary antioxidant is slow rate of oxidation reactions with reducers and chelators of metal ions. They provide hydrogen to primary antioxidants that decompose hydroperoxide to nonradical species, deactivate singlet oxygen, absorb ultraviolet radiation or act as oxygen scavengers (Reische et al.,2002).

The food phenolics render antioxidant activity mainly due to their role as reducing agents, hydrogen donors, singlet oxygen quenchers and ability to chelate metal ions (Embuscado, 2015). Spices and herbs are good source of phenolic compound and a long history of safe usage and used as a natural antioxidant. Phenolic compounds are bioactive substances widely distributed in herb and spices act mostly as radical scavengers and some are act as metal chelators. Spices and herbs have desirable properties such as natural and clean label ingredients.

Food contamination is enormous public health problem, but it could be controlled by the use of natural preservatives such as essential oils obtained from spices. The type and optimal concentration of essential oil (EO) depend on the product used and against which species of bacteria or fungi it is to be used. But if EOs are expected to be widely applied as antibacterial and antifungal, the organoleptic impact should be considered as the use of naturally derived preservatives can alter the taste of food or exceed acceptable flavour thresholds.

NATURAL ANTIOXIDANT AND ANTIMICROBIAL ACTIVITY OF SOME SPICE AND HERBS

Ginger (Zingiber officinale Roscoe)

Ginger is a common condiment for various foods and beverages. They owned as a fresh paste, dried powder, slices preserved in syrup or brine, candy (crystallized ginger); as a flavoring agent in beverages and preparing vegetable and meat dishes (Shukla and Singh, 2006; John, 2008).

Ginger, a source of valuable phytonutrients, is characterized as having an aromatic odor and a pungent taste (Bruneton, 1995). The ginger rhizome is a rich source of secondary metabolites such as phenolic compounds (gingerol, paradol and shogaoal), volatile sesquiterpenes (zingiberene and bisabolene) and monoterpenoids (curcumeneandcitral) (Alietal., 2008).

Ginger products, such as the essential oil and oleoresin, are internationally commercialized for use in food processing. Ginger oleoresin is obtained bysolventextraction of dried ginger. This product possesses the full organoleptic properties of the spice, i.e. aroma, flavor and pungency, which used for flavoring of processed foods and beverages. Ginger oil, obtained by steam distillation of the ginger rhizome. Commercial ginger oil is obtained by steam distillation of coarsely ground dried ginger rhizome. This product possesses the aroma and flavour of the spice but lacks the pungency, which applied for the flavoring of beverages, confectionery and perfumery (Wohlmuth et al., 2006). Preserved ginger is used both for domestic culinary purposes and in the manufacture of processed foods such as jams, marmalades, cakes and confectionery.

Ginger traditionally used for varied human ailments, to aid digestion and to treat stomach upset, diarrhea and nausea. Ginger is a natural dietary component which has antioxidant and anticarcinogenic properties (Manju and Nalini, 2005).

Active constituent of Ginger

Ginger has produced volatile and nonvolatile compounds to offer its organoleptic properties. The odour and flavour of ginger are determined by the constituents of its steam volatile oil. The main components of ginger oil is comprised sesquiterpene hydrocarbons [zingiberene (21.8%), □-bisabolene (7.9%), □-phellandrene (3.1%), methyl nonyl ketone (1.6%) and camphene (1.4%)]; oxygenated monoterpenes [geranial (9.9%), geraniol (9.4%), nerol (7.1%), 1:8-cineol (6.2%),□-terpineol (5.6%), borneol (5.4%), linalool(1.7%)] and monoterpene hydrocarbons accounted for <1% each of the volatile oil (Miyazawa and Kameoka,1988; Lawrence,1995b).

In other way, the pungency of ginger attributed by non steam-volatile components, known as gingerol and zingerone. Ginger oleoresin extracted from rhizomes with ethanol, isopropanol or liquid carbon dioxide. All oleoresin had monoterpenes and sesquiterpenes. The best oleoresin contains all the flavour components contributing to aroma, taste, pungency and related sensory factors (Vernin and Parkanyl, 2005; John,2008).

Antioxidant activity

The potential of ginger in the culinary, non-culinary and medicinal fields is based on the properties of volatile oil and non-volatile pungent principles. The oil yield is about 2–3% and the oil consists of 64% sesquiterpene hydrocarbons, 6% carbonyl compounds, 5% alcohols, 2% monoterpene hydrocarbons and 1% esters. The essential oil and oleoresin of Zingiber offinale exhibited significant antioxidant and antimicrobial activities (Bellik, 2014). Ginger and its constituents show antioxidant activity and prevent the damage of macromolecules, caused by the free radicals/oxidative stress (Arshad et al., 2014).The pungent compounds of ginger include gingerols, shogaols, paradols and zingerone, which produce a ‘hot’ sensation in the mouth (John, 2008).

The non-volatile fraction of the dichloromethane extract of ginger rhizomes exhibited a strong antioxidative activity using linoleic acid as the substrate in ethanol- phosphate buffer solution. The fraction purified by chromatographic techniques to provide five gingerol- related compounds and eight diarylheptanoids (Kikuzaki and Nakatani, 1993).

Studies by Stoilova et al. (2007) shown that high antioxidant activity of ginger extract with total phenols (870.1 mg/g dry extract) in alcoholic form; 2,2-Diphenyl- 1-picril hydrazyl radical (DPPH) scavenging (90.1%) and butylated hydroxyl toluene (BHT). Ginger extract inhibited hydroxyl radicals by 79.6% at 37°C and 74.8% at 80°C while inhibited thiobarbituric acid-reactive substances (TBARS) by 71.6% at 73.2% using linoleic acid/water emulsion system which showed a higher antioxidant activity than quercetin (Stoilova et al.,2007).

The ginger as antioxidant showed that 6-shogaol has potent antioxidant properties which can be attributed to the presence of unsaturated ketone moiety (Dugasani et al., 2010). Another study has shown that phenolic substances possess strong anti-inflmmatory and antioxidative properties and considerable anticarcinogenic and antimutagenic activities (Khader et al., 2010). (Table3)

Antimicrobial Activity

Ginger contain good source of active antimicrobial and other bioactive components such as gingerol, paradol, shogaols and zingerone. Ginger has effective against the growth of both gram-positive and gram negative bacteria. An important finding showed that 10% ethanolic ginger extract was found to possess antimicrobial potential against pathogens (Giriraju and Yunus, 2013).

The methanol and n-hexane extracts of Zingiberoffiinale rhizomes had more effective against the Gram- positive (S. epidermidis, S. aureus) compared with Gram- negative bacteria (Hasan et al., 2012). Additionally, the extracts had an inhibitory effect on the growth of fungi (candedaalbicans) because of its monoterpene content. Since the mechanism by which ginger act as anti-fungal and antimicrobial action through the disruption of bacteria or fungal membrane integrity (Deba et al., 2008). (Table 2)

Garlic (Allium sativum L)

Garlic consumed as form of whole bulbs, cloves, dried (granules, powder and dried powder with salt), garlic oil and garlic juice (Charles, 2013).

Active constituent of garlic

Garlic powder contains moisture (5 mg/100g), protein (17.5 mg/100g), fiber (2 mg/100g) and carbohydrates (71mg/100g) (Charles, 2013). Garlic contains 0.1–0.4% volatile oil, alliin, enzymes, ajoenes, minerals and proteins. The major active constituent in oil is the sulfur containing compounds (allicin). Allicin is the main odor producing ingredient with the action of the enzymealliinase onalliin.

Allicin is thiosulfinates which produced upon garlic tissue damage from non-proteinogenic amino acid alliin in a reaction that is catalyzed by the enzyme alliinase (Eric, 1985). The precursor of allicin is S-allyl-L-cysteine sulfoxide (alliin) which give the characteristic of garlic odor (Amagase, 2006). Alliin are hydrolysed by alliinase that leads to production of dehydroalanine and allyl sulfenic acid (Ilić et al., 2011).

Antioxidant properties

Garlic have free radical-scavenging characteristics and identifiable odors at low concentrations. They contain two main antioxidant compounds: flavonoids (flavones and quercetins) and sulfur-containing compounds (allyl- cysteine, diallyl sulfide, and allyl trisulfide). The sulfur- contain in gaminoacid derivative, alliin (S-allyl-L-cysteine sulfoxide), can be converted into allicin (diallyl disulfide- S-oxide), the compound commonly associated with garlic odor, by the enzyme alliinase. The combination of the allyl group ($–CH_2CH=CH_2$) and the –S(O)S– group is necessary for the antioxidant action of thiosulfinates in garlic extracts (Okada et al., 2005). Study made By Duda et al., (2008) reported garlic preparation had significantly lowering lipid peroxidation products in blood and increase vitamin E concentration in serum of patients. Additionally, Aged garlic extract (AGE) and S -allylcysteine (SAC) had scavenging reactive oxygen species (ROS) (inhibit oxidation of low density lipoprotein (LDL)) and inhibit the injury to endothelial cells by oxidized LDL invitro system exposed to oxidant copper ions (Ide and Lau, 1997). Aguirrezábal et al. (2000) compared the antioxidant effect of garlic with a mixture of nitrate, nitrite and ascorbic acid in dry sausage, and they noted that garlic was as effective as the mixture of additives in inhibiting lipid oxidation. (Table1)

Antimicrobial activity of Garlic

Allicin (diallylthiosulfinate) is a defense molecule from garlic with a broad range of biological activities. It shows a broad spectrum of effects on a variety of fungal species which makes a possible application of allicin in medicinal therapy and agriculture an attractive possibility. The garlic ethanolic extract was found to be most effective in inhibiting the microbial growth (Baljeet et al., 2015). On the basis of allicin effects on S. cerevisiae, it is apparent that the redox-effect of allicin seems to be a central, but not exclusive explanation of allicin fungicidal activity (Jan et al., 2014). Garlic oil and allylalcohol from garlic inhibited Candida utilis in different ways: Garlic oil had fungistatic activity while allyl alcohol had fungicidal activity. Both had good antimicrobial potencies against the yeast (Chung et al., 2007). (Table2)

Rosemary (Rosmarinus officinalis L.)

Rosemary leaves and flowering tops yield an essential oil and oleoresin valued in aromatherapy, traditional and modern medicine as well as in the perfumes and flavour industries. Rosemary leaves are conventionally used with roasted meat or fish dishes, they can also be used in vegetable preparations as well.

Active constituent of Rosemary

The extraction of active compounds in rosemary leafs are mostly performed by conventional solvent extraction techniques (solvents), distillation (steam or water) and super-critical fluid extraction (SFE) (CO_2) (Chang et al., 1977; Rezzoug et al., 2000). Comparing extraction process SFE found superior to liquid solvent sonication for maximum recovery of

Table 1: Antioxidant compounds and their mode of action in commonly used spices and herbs

Spice	Part of the spice used	Antioxidant compounds	Mode of action
Garlic	Bulb	Phenolic compound , S-allyl-L-cysteine-sulphoxide (alliin), thiosulfinates and allyl group ($-CH_2CH=CH_2$) and the –S(O)S– group	Free radical-scavenging characteristics
Ginger	Root	Shogoal, gingerol, zingerone	Free radical scavenger
Rosemary	Leaf	Carnosol, 12-O-methylcarnosic, rosmanol, caffeic acid, rosmarinic acid, caffeoyl derivatives, phenolic diterpenes (carnosic acid), carnosol, epirosmanol, flavonoids	Scavenge superoxide radicals, lipid antioxidant and metal chelator
Turmeric	Root	Curcumin, 4-hydroxycinnamoylmethane	Free radical scavenger

Sources: Okada, 2005; Brewer, 2011; Embuscado, 2015

Table 2: Antimicrobial compounds and their mode of action in commonly used spices and herbs

Spice	Antimicrobial compounds	Mode of action
Garlic	Oxygenated sulphur compound, thio-2-propene-1-sulfinic acid Sallyl ester, allyl group (−CH2CH=CH2) and the −S(O)S− group	Anti bacterial effect (Escherichia, Salmonella, Staphylococcus, Streptococcus, Klebsiella, Proteus, Clostridium, Mycobacterium and Helicobacter species).
Ginger	Methanol extracts	Bacteriostatic effect (Conc.0.075%) (S. aureus, L. monocytogenes, Camphylobacterjejuni, Salmonella enteritidis, E.coli)
Rosemary	Carnosol, 12-O-methylcarnosic, rosmanol, caffeic acid, rosmarinic acid, caffeoyl derivatives, phenolic diterpenes (carnosic acid), carnosol, epirosmanol, flavonoids	
Turmeric	Curcumin, 4-hydroxycinnamoylmethane	

Sources: Bakri and Douglas, 2005; Sameem et al., 2011 and Ahmed et al., 2013

carnosic acid in pure form (Tena et al., 1997) and steam distillation found better in terms of yield and quality profile of rosemary oil (Boutekedjiret et al., 1997). In other way, fresh and in shade-drying rosemary leaves had a significant impact on oil content of 1% and 3%, respectively (Farooqi and Sreeramulu, 2001). Additionally, blanching have a positive effect on retention of the antioxidant principles and green color of rosemary but blanching leads to total loss of volatile oils (Singh et al., 1996). The composition of rosemary oil is 1,8-cineol (30–40%), camphor (15– 25%), borneol (16– 20%), bornyl acetate (up to 7%), -pinene (25%) as well as -pinene, linalool, camphene, etc (Prakasa et al.,1999).

Antioxidant

The most active antioxidative constituents of rosemary are phenolic diterpenes (carnosic, carnosol, rosmanol, rosmadial, 12-methoxycarnosic acid, epi-, and iso- rosmanol) and phenolic acids (rosmarinic and caffeic) (Nakatani, 2003; Carvalho et al., 2005).

Chen et al., (2007) study reported that the aqueous extract of rosemary contained the highest concentration of phenolic substances (185 mg/g; Folin–Ciocalteau) and total flavonoids (141 mg/g). At 100 mcg/mL, rosemary extract was able to scavenge 39% of the DPPH radicals (0.2 μm); at 500 mcg/mL, it scavenged 55%. Rosemary extract (100 mcg/mL) inhibited liposome (egg lecithin with Fe3+/AA/H2O2) oxidation by 98% (Brewer,2011).

Carnosic acid has several times the antioxidative activity as BHT and BHA (Richheimer et al.,1996).The synthetic phenolic antioxidants, BHA and BHT, each have a single aromatic ring with 1 – OH group capable of donating H. While carnosic acid also has a single aromatic ring, it has 2 – OH groups that can serve as H donors. In addition, vicinal –OH groups can chelate pro oxidative metals thereby preventing oxidation via 2 mechanisms. The polyphenol, rosmarinic acid has 2 aromatic rings, each with 2 – OH groups that are capable of donating Hand chelating metals. Adding α-tocopherol to rosemary can have either an

Table 3: Antioxidant activities and total phenolic content of spices and herbs

Spice/Herb	Scientific name	Antioxidant content (FRAP) (mmol/100g)	DPPH (%) Inhibition	Total phenolic content(mg/g)
Ginger	Zingiberofficinale	19.5-20.3	31.8	3.17-20
Turmeric	Curcuma longa	10.2	9.6	14.5-21.17
Rosemary	Rosmarinus officinal	44.8-47.9	48.2-90.1	

antagonistic effect (Hra et al., 2000) or a synergistic effect. This may indicate that there are components in rosemary, other than rosmarinic acid, which make substantial contributions to the antioxidative capacity of the extract. It may also be a function of the solubility of the rosemary fractions used compared to that of α-tocopherol with respect to the food system to which it being added.

In lipid-based systems, carnosic acid and carnosol effectively chelate iron and scavenge peroxyl radical (Arouma et al., 1992). However, free radical-scavenging activity ability does vary among the different compounds: 1,8-cineole = 62.5%, β -pinene = 46.2%, and α -pinene = 42.7% found in rosemary essential oil. The ethanol extract of rosemary h as higher antioxidative activity than d o the individual phenolic compounds (carnosic acid, carnosol, 1,8-cineole, α-pinene, camphor, camphene, an d β -pinene) separately (Hernandez-Hernandez et al., 2009). (Table3)

Turmeric (Curcuma longa L.)

Turmeric is a rhizomatous herbaceous perennial plant of the ginger family, Zingiberaceae (Shiyou et al., 2011).Itis bitter and slightly pungent; woody-spicy aroma; bright orange color for fresh turmeric while pale to orange yellow for dried rhizomes (Chempakam and Parthasarathy, 2008). Turmeric is used as dehydrated powder, oils and oleoresin from fresh or whole rhizome. Its oleoresin is used in most food processing industries (Charles, 2013). Turmeric used as a food color andto impart a characteristic mild spicy aroma. Turmeric has been expanded as a medicinal spice throughout Asia for centuries (Chinese and indian). In traditional medicine, it is primarily owned as a treatment for inflammatory conditions and for skin diseases (Anon, 2001; Remadevi et al., 2007).

Turmeric ingredient and composition

The turmeric rhizome contains the proximate composition (6–9 g/100g protein, 5–10 g/100g fat, 60–70 g/100g carbohydrate (starch), 2–7 g/100g fiber and 390 kcal energy); mineral content (2000 mg/100g K, 0.2 mg/100g Ca, 47.5 mg/100g Fe, 30 mg/100g Na, 260 mg/100g P); vitamin (ascorbic acid, vitamin C); curcuminoids and (2–10%) essential oil. The essential oil contains ar-turmerone (60%), curlone, ar-curcumene, zingiberene, a-phellandrene and sabinene (Charles, 2013).

Turmeric are used industrially to extract the volatile oil from dried rhizomes and leaves that account 5–6% and 1.0–1.5% oil, respectively (Chempakamd Parthasarathy, 2008).They comprises 15–20% volatile oil and 30–40% curcumin. Fresh rhizome oil contains zingiberene (16.7%), ar-turmerone (15.5- 25.7%),α-phellandrene (10.6%), α-turmerone (30.1–32.0%) and β- turmerone (14.7–18.4%) on the basis of growing location (Sharma et al., 1997). The volatile oil is extracted commonly by steam distillation and supercritical extraction method that contributes aromatic taste and smell. The residue on steam distillation yields mainly sesquiterpene alcohols with low-boiling terpenes (d- sabinene, α-phellandrene, cineole, borneol) and the higher-boiling sesquiterpene (zingiberene). Additionally, ketonicsesquiterpenes (ar-turmerone and turmerone) are responsible for the aroma of turmeric (Masuda et al., 2001).

Ground turmeric curcuminoid primarily consists curcumin, dimethoxycurcumin andbisdimethoxy curcumin and 2,5-xylenol. Curcumin is the major coloring pigment which is soluble in ethanol and acetone. Thus, this active ingredient curcumin has good antioxidant properties (Charles, 2013).

Antioxidant

In addition to coloring pigment, curcumin are natural phenolic compounds with potent antioxidant properties (Subramonian et al., 1994; Ruby et al., 1995). Curcumin is a classical phenolic chain-breaking antioxidant by donating H from the phenolic groups (Ross et al., 2000). Compared with synthetic antioxidant, curcumin perform better antioxidant characteristics than BHT (Jayaprakashaa et al., 2006). Curcumin is highly effective in neutralizing free radicals (Yu et al.,2008).

Curcumin has inhibit lipid peroxidation in which polyunsaturated fatty acid is oxidized and formed fatty acid radical. Masuda et al., (2001) reported that curcumin acts as a chain-breaking antioxidant with three position and resulting intra molecular Diels–Alder reaction and neutralization of lipid radicals. The curcumin has used as prevention of lipid peroxidation with retarding the formation of hydroxyl free radicals and intervening in ther propagation (Sreejayan and Rao, 1994). Possible sites to attack free radical oxidants with curcum in and stabilization of phenoxyl intermediate and its regeneration by ascorbic acid.

Furthermore, turmeric oil has a free radical-scavenging ability comparable to vitamin E and BHT. The major components of turmeric oil are α- and β-turmer one, curlone, and α-terpineol which is responsible for this antioxidant activity (Carolina et al., 2003). Cumin essential oil is better at reducing Fe^{3+}ions than dried or fresh ginger.

Curcumin also has the potential to prevent oxidative damage to the arterial wall. Thus, administration of 500 mg of curcuminoids daily to healthy humans for 7 days reduced lipid peroxides by 33% and blood cholesterol by 29%, indicating a possible role of curcumin in reducing cardiovascular diseases (Soni and Kuttan, 1992). In addition, it has been shown to scavenge various ROS produced by macrophages (superoxide anions, hydrogen peroxide, and nitrite radicals).

CONCLUSION

The interest of natural ingredients in food and beverage industries has increasing because synthetic antioxidants may an adverse consumers health effects. The extract of garlic, ginger, rosemary and turmeric extract are play role for preservation and improve the flavor and color of food and beverage industries. Additionally, they act as a natural antioxidant and antimicrobial characteristics because they contain excellent source of phenolic compound. They preserve from oxidation, undesirable chemical change, rancid odour and retard microbial growth because of their active constituent.

REFERENCES

Ahmed O, Sahu N and Pal A (2013). Antioxidant activity and antimicrobial property of some Indian spices. International Journal of Scientific and Research 3(3).

Ali B, Blunden G, Tanira M and Nemmar A (2008). Some phytochemical, pharmacological and toxicological properties of ginger (Zingiberofficinale Roscoe): A review of recent research. Food Chemistry and Toxicology 46:409-420.

Amagase H (2006). Clarifying the real bioactive constituents of garlic. Journal of Nutrition 136 (3):716– 725.

Anon (2001).Wealth of India – Raw Materials, Volume II. Council of Scientific and Industrial Research, New Dehli,India.

Arouma O, Halliwell B, Aeschbach R and Loligers J (1992). Antioxidant and pro-oxidant properties of active rosemary constituents: carnosol and carnosic acid. Xenobiotica22:257–68.

Arshad H, Fahad M and Salah M Aly (2014).Active ingredients of ginger as potential candidates in the prevention and treatment of diseases via modulation of biological activities. International Journal of Pathophysiology Pharmacology 6(2):125-136.

Bakri I and Douglas C (2005). Inhibitory effect of garlic extract on oral bacteria. Arch Oral Biology 7: 645-51.

Baljeet S, Simmy G Ritika Y and RoshanlalY(2015). Antimicrobial activity of individual and combined extracts of selected spicesagainst some pathogenic and food spoilage microorganisms. International Food Research Journal 22(6):2594-2600.

Bellik Y (2014). Total antioxidant activity and antimicrobial potency of the essential oil and oleoresin of Zingiberoffiinale R. Asian Pacific Journal of Tropical Disease 4: 40-44.

Boutekedjiret C, Benhabiles N, Belabbes R and Bessiere J (1997). Effect of mode of extraction on yield and composition of the essential oil of Rosmarinus officinalis. RivistaItaliana EPPOS 22:33–35.

Brewer M (2011). Natural Antioxidants: Sources, Compounds, Mechanisms of Action, and Potential Applications. Comprehensive Reviews in Food Science and Food Safety 10.

Bruneton J (1995). Ginger. Pharmacognosy,Phytochemistry, Medicinal plants, Lavoisier publishing Com. Inc. 258-261.

Carolina C, Manzan M, Toniolo F, Bredow E and Povh N (2003).Extraction of essential oil and pigments from Curcuma longa by steam distillation and extractionwith volatile solvents. Journal of Agricultural and Food Chemistry51(23):6802–6807.

Carvalho R, Moura L, Rosa P and Meireles M (2005). Supercritical fluid extraction from rosemary (Rosmarinus officinalis): kinetic data, extract's global yield, composition, and antioxidant activity. Journal of Supercritical Fluids35:197–204.

Ceylan E and Fung (2004).Antimicrobial activity of spices. Journal of Rapid Methodology Aut.Mic. 12: 1– 55.

Chang S, Ostic-Matijasavic B, Hsieh O and Huang C (1977).Natural antioxidants from rosemary and sage. Food Science42:1102–1106.

Charles D (2013). Antioxidant Properties of Spices, Herbs and Other Sources.Springer Science+Business Media NewYork.

Chempakam B. and Parthasarathy (2008). Spice chemistry. Turmeric.Indian Institute of Spices ResearchCalicut, Kerala, India.

Chen H, Lin Y and Hsieh C (2007). Evaluation of antioxidant activity of aqueous extract of some selected nutraceutical herbs. Food Chemistry 104(4):1418– 1424.

Chung I, Kwon S, Shim S and Kyung K (2007). Synergistic antiyeast activity of garlic oil and allyl alcohol derived from alliin in garlic. Journal of Food Science72(9):437–440.

Deba F, Xuan T, Yasuda M and Tawata S (2008). Chemical composition and antioxidant, antibacterial and antifungal activities of the essential oils from Bidenspilosa Linn. Var. Radiata. Food Control 19: 346–35.

Decker E, Elias R and Mc Clements D (2010). Oxidation in foods and beverages and antioxidant applications. Oxford: Wood head Publishing.

De guzman C and Sienonsma J (1999). Plant Resources of South East Asia.No. 13.Spices.Backhuys Publishers, Leiden, TheNetherlands.

Dugasani S, PichikaM, Nadarajah V, Balijepalli M, Tandra S and Korlakunta J (2010). Comparative antioxidant and anti-inflmmatory effects of[6]-gingerol, [8]-gingerol, [10]-gingerol and [6]-shogaol. Journal of Ethnopharmacology 127:515-520.

Duda G, Suliburska J and Pupek-Musialik D (2008).Effects of short-term garlic supplementation on lipid metabolism and antioxidant status in hypertensive adults. Pharmacology Rep 60(2):163–170.

Embuscado M (2015). Spices and herbs: Natural sources of antioxidants - A mini review. Journal of Functional Foods.

Eric B (1985).The chemistry of garlic and onions.
Scientific American 252 : 3.

Farooqi A and Sreeramulu B (2001).Cultivation of Medicinal and Aromatic Plants. University Press India Ltd, Hydrabad, India, pp. 433–443.

Gad A and Sayd A (2015). Antioxidant properties of rosemary and its potential uses as natural antioxidant in dairy products. A Review. Food and Nutrition Sciences 6:179-193.

Gilgun Y, Melamed E and Offen D (2001). Oxidative stress induced-neurodegenerative diseases: The need for antioxidants that penetrate the blood brain barrier. Neuropharmacology40:959-975.

Giriraju A and Yunus G (2013). Assessment of antimicrobial potential of 10% ginger extract against Streptococcus mutans, Candida albicans, and Enterococcus faecalis: an in vitro study. Indian Journal of Dental Research 24: 397-400.

Gutierrez J, Barry-Ryan C and Bourke P (2009). Antimicrobial activity of plant essential oils using food model media: Efficacy, synergistic potential and interactions with food components. Food Microbiology 26(2): 142-150

Hasan H, Rasheed R, Abd Razik B and Rasool H (2012). Chemical Composition and Antimicrobial activity of the crude extracts isolated from Zingiber Offiinale by different solvents. Pharmaceutical Analytical Acta 3: 184.

Hernandez-Hernandez E, Ponce-Alquicira E, Jaramillo-Flores M and Guerrero-Legarreta I (2009).Antioxidant effect of rosemary (Rosmarinusofficinalis L.)and oregano (Origanum vulgare L.) extracts on TBARS and colour of model raw pork batters. Meat Science 81(2): 410–417.

Hra H, Hadolina M, Knez E and Bauman D (2000). Comparison of antioxidative and synergistic effects of rosemary extract with α-tocopherol, ascorbyl palmitate and citric acid in sunflower oil. Food Chemistry 71(2): 229–233.

Ide N and Lau B (1997). Garlic compounds protect vascular endothelial cells from oxidized low density lipoprotein-induced injury. Journal of Pharmacy Pharmacology 49:908–911.

Ifesan B, Fadipe E and Ifesan T (2014).Investigation of Antioxidant and Antimicrobial Properties of Garlic Peel Extract (Allium sativum) and Its Use as Natural Food Additive in Cooked Beef. Journal of Scientific Research and Reports 3(5): 711-721.

Ilić D, Nikolić V, Stanković M, Stanojević L and Cakić M (2011).Allicin and related compounds: Biosynthesis, synthesis and pharmacological activity. Facta University. Physical Chemistry Technology 9:9–20.

Ippolito A and Nigro F (2003). Natural antimicrobials in the postharvest storage of fresh fruits and vegetables. In natural antimicrobials for the minimal processing of foods, Roller, S. (ed.), Woodhead Publishing Limited, Cambridge.

Jan B, FrankA, Martin C, Gruhlke, Ifeanyi D, Nwachukwu and Alan J (2014). Allicin: chemistry and biological properties. Journal of molecules 19:12591-12618.

Jayaprakashaa G, Rao L and Sakariaha K (2006).Antioxidant activities of curcumin, demethoxycurcumin and bisdemethoxycurcumin. Food Chemistry 98(4):720–724.

John Z (2008). Chemistry of spice. Ginger. Indian

Institute of Spices Research Calicut, Kerala, India.p (70-97).
Khader M, Bresgen N and Eckl P (2010).Antimutagenic effects of ethanolic extracts from three Palestinian medicinal plants. Journal of Ethnopharmacology 127: 319-324.
Kikuzaki Hand Nakatani N (1993). Antioxidant effects of some ginger constituents. Journal of Food Science 58 (6):1407–1410.
Lawrence B (1995b). Progress in essential oils. Perfumer and Flavorist20: 49-59.
Marija M and Nevena T (2009). Antimicrobial effects of spices and herbs essential oils.
Manju V and Nalini N (2005). Chemo preventive efficacy of ginger, a naturally occurring anticarcinogen during the initiation, post-initiation stages of 1,2- dimethylhydrazine induced colon cancer. Clinical ChimicaActa358 (1):60–67.
Masuda T, Maekawa T, Hidaka K, Bando H, Takeda Y and Yamaguchi H (2001). Chemical studies on antioxidant mechanism of curcumin: analysis of oxidative coupling products from curcumin and linoleate. Journal Agricultural and Food Chemistry 49(5):2539–2547.
Miyazawa M and Kameoka H (1988).Volatile flavour components of ZingiberisRhizoma (Zingiberofficinale Roscoe). Agricultural and Biological Chemistry 52(11): 2961–2963.
Nakatani N (2003). Biologically functional constituents of spices and herbs. Journal of Society Nutrition and Food Science 56 (6):389–395.
Nawar W (1996). Lipids. In: Fennema O, editor. Food chemistry.3rd edition. New York: Marcel Dekker, Inc. p 225-320.
Okada Y, Tanaka K, Fujita I, Sato E and Okajima H (2005). Antioxidant activity of thiosulfinatesderived from garlic. Redox 10(2):96–102.
Peter (2004). Hand book spice and herbs. vol. 2.Introduction. Kerala Agricultural University, Indiaand
K. NirmalBabu,Indian Institute of Spices Research, India., Woodhead PublishingLtd.
Prakasa R, Gopinath C, Ganesha R and Ramesh S (1999). Agronomic and distillation studies on rosemary (Rosmarinus officinalis L.) in a semi arid tropical environment. Journal of Herbs, Spices and Medicinal Plants6(3):25–30.
Reische D, Lillard D and Eitenmiller R (2002).Antioxidants. In: Akoh, C.C. and Min, D.B., Eds., Food Lipids: Chemistry, Nutrition and Biotechnology, Marcel
Dekker, New York, 489-516.
Remadevi R, SurendranE and Kimura T (2007). Turmeric in Traditional medicine.In Turmeric: the genus Curcuma. CRC Press: Boca Raton, London, New York,409-436.
Rezzoug S, Louka N And Allaf K (2000). Effect of main processing parameters of the instantaneous controlled pressure drop process on oil isolation from rosemary leaves – kinetic aspects. Journal Essential Oil Research12 (3):336–344.
Richheimer S, Bernart M, King G, Kent M and Bailey D (1996).Antioxidant activity of lipid-soluble phenolic diterpenes from rosemary. Journal of American Oil Chemistry Society 73 (4):507–514.
Ross L, Barclay R, Vinqvist M, Mukai K, Goto H, Hashimoto Y, Tokunaga A and Uno H (2000). On the antioxidant mechanism of curcumin: classical methods are needed to determine antioxidant mechanism and activity. Original Let 2 (18):2841–2843.
Ruby A, Kuttan G, Dinesh B, Rajasekharan and Kuttan R (1995). Antitumor and antioxidant activity of natural curcuminoids. Cancer Letters 94: 79–83.
Sati Y, Al-Dalain A and Al-Fraihat E (2011). Effect of aromatic plant essential oils on oxidative stability of sunflower oil during heating and storage. Pakistan Journal of Nutrition10: 864-870.
Sameem M, Issa M, Atif M, Wasim M, Ahmad A and Adnan M (2011). Garlic (Allium Sativum L.) as an antimicrobial and antioxidant agent in beef sausages. Pakistan Journal of Food Sciences, 21(1-4):22-32.
Sharma O (1996). Antioxidant activity of curcumin and related compounds. Biochemical Pharmacology 25: 1811–1812.
Shiyou L, Wei Y, Guangrui D, Ping W, Peiying Y and
Bharat B (2011). Chemical composition and product quality control of turmeric (Curcuma longa L.). Pharmaceutical Crops 2: 28-54.
Shukla, Y. and Singh, M. (2006). Cancer preventive properties of ginger: a brief review. Food and Chemical Toxicology 45 (5): 683–690.
Singh M, Raghavan B and Abraham K (1996). Processing of marjoram (Marjoram hortensis M) and rosemary (Rosmarinus officinalis L) – effect of blanchingmethodonquality.Nahrung40(5):264–266.
Soni K and Kuttan R (1992). Effect of oral curcumin administration on serum peroxides and cholesterol levels in human volunteers. Indian Journal of Physiology and Pharmacology 36(4): 273–275 and 239–243.
Sreejayan N and Rao M (1994). Curcuminoids as potent inhibitors of lipid peroxidation. Journal ofPharmacy and Pharmacology 46: 1013–1016.
Stoilova I, Krastanv A, Stoyanova A, Denev P and Gargova S (2007). Antioxidant activity of a ginger extract (Zingiberofficinale). Food Chemistry102: 764– 770.
Subramonian M, Sreejayan R, Devasagayam T and Singh B (1994). Diminuition of singlet oxygen induced DNA damage by curcumin and related antioxidants. Mutation Research311:249–255.

Tena M, Valcarcel M, Hidalgo P and Ubera J (1997). Supercritical fluid extraction of natural antioxidants from rosemary: comparison with liquid solvent sonication. Analytical Chemistry 69 (3): 521–526.

Vernin G and Parkanyl C (2005).Chemistry of ginger.In: Ravindran, P.N. and NirmalBabu, K. (eds) Ginger,The Genus Zingiber. CRC Press, New York, pp.87–180.

Wohlmuth H, Smith M, Brooks L, Myers S and Leach D (2006). Essential oil composition of diploid and tetraploid clones of ginger (Zingiberofficinale Roscoe) grown in Australia. Journal of Agricultural and Food Chemistry54 (4):1414–1419.