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Invited article

Herbs that heal: Natural panacea for health promotion

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Abstract

Kitchen has always been one of the most attractive places for health related studies since food connects health and wellness. Epidemiological and clinical studies have repeatedly shown the health promoting properties of culinary herbs. Present article deals with description of healing properties of curcumin (*Curcuma longa* L.) garlic (*Allium sativum* L.) and ginger (*Zingiber offcinale* Roscoe), the major constituents of spices used in kitchen.

Key words: Herbs, spices, medicine, health, disease

1. Introduction

Since ancient times, herbs have been used by humans as food and to treat health ailments. A growing body of evidence has demonstrated that aromatic herbs used as spices possess potent therapeutic properties which may provide significant protection against many deleterious human diseases (Viuda-Martos *et al*., 2010; Singh *et al*., 2012; Yashin *et al*., 2017; Rakhi *et al*., 2018). Sumerians were the first, who are documented to use thyme (*Tymus vulgaris*) for its health promoting effects date back to 5000 BC (Viuda-Martos *et al*., 2010). In later centuries, Indians and Egyptians are mentioned to use garlic, ginger, curcumin, coriander and many other herbs as spices in their food, the trend was followed by other part of the world (Bellamy and Pfister, 1992). Now, spices have been established as incumbent part of human food and are used in all the cultures in more or less amount. An array of evidence present in the literature refereed by experimental and clinical studies, describes health promoting effects of these culinary herbs (Biradar, 2015; Yashin *et al*., 2017; Rakhi *et al*., 2018). Spices have been reported to impart taste, flavor, improve digestive capability and prevent spoilage of the food (Viuda-Martos *et al*., 2010).

Recently, interest on herbal medication to protect the health has increased all over the world due to everlasting serious side effects of synthetic drugs (Manoharachary and Nagaraju, 2016; Mohammad *et al*., 2017; Rakhi *et al*., 2018). Role of diet in health and diseases has already been established (Pandey and Rizvi, 2009; Rajeshwari *et al*., 2014; Pandey, 2017; Owen and Corfe, 2017), however, concept of adequate nutrition is still been a topic of debate and research which includes the components, type and quantity of food (Guldiken *et al*., 2018).

Increasing culinary and health related beneficial effects of spices have attracted the researchers and food and pharma industries to explore the medicinal properties of the spices, followed by investigation of bioactive compounds present in them and to their bioavailabilities in order to develop potential drugs to cure health alignments. Present article deals with description of healing properties of curcumin, garlic and ginger, the major constituents of spices used in kitchen.

2. Curcumin (*Curcuma longa* L.)

Curcumin is a bioactive yellow component of turmeric (*Curcuma longa* L.), an herb with tuberous shoot and yellow flowers. This tropical plant belongs to the family Zingerbeaceae whose growth and nutritional potency depends upon the type of the soil and environment where it grows (Singh *et al*., 2016; Kocaadam and Aanlier, 2017). The analytical studies have shown that turmeric powder obtained from a tropical healthy plant contains carbohydrate as major part, followed by protein and fat (Prasad *et al*., 2014). Curcumin is a lipophilic polyphenolic compound which constitutes about 5% of the turmeric powder in which curcumin shares lager percentage (77%), followed by demethoxycurcumin (DMC); approximately 17% and 3% by bidemethoxycurcumin (BDMC) (Goel *et al*., 2008). Chemically, curcumin ($C_{21}H_{20}O_6$) is represented as 1,7-bis-(4-hydroxy-3-methoxyphenyl)-hepta-1,6-diene-3,5-dione or dipheruloylmethane (Deogade and Ghate, 2015).

Being lipophilic in nature, the bioavailability of curcumin is low which limits the *in vivo* biological activities of this phenolic compound. Recent experiments have reported that use of curcumin nanoparticles and/or ligand bound delivery of curcumin have enhanced its bioavailability and, thus *in vivo* effects (Devassy *et al*., 2015; Rakotoarisoa and Angelova, 2018). It has been documented that curcumin also possess biological activities, through its metabolites which includes dihydrocurcumin (DHC), tetrahydrocurcumin (THC), octahydrocurcumin (OHC), hexahydrocurcumin (HHC), curcumin glucuronide, and curcumin sulfate (Prasad *et al*., 2014). In ancient days, curcumin was mainly used for color but later years after recognition of its therapeutic properties, it has become an essential part of kitchen.

2.1 Healing properties

In Ayurveda and conventional Chinese medicinal system, curcumin has been used to treat a wide range of disorders and promote health

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(Singh *et al*., 2016; Kocaadam and Aanlier, 2017; Kim and Clifton, 2018). In mid-nineteenth century, after its extraction by Vogel and Pelletier, curcumin was scientifically stated as the substance carrying antibacterial properties (Kocaadam and Aanlier, 2017). Curcumin was then reported to be effective against wide range of bacteria including *Mycobacterium tuberculosis* and *Salmonella parathphi* (Moghadamtousi *et al*., 2014). In 20th century, much work was carried out in different laboratories on different model systems including humans in different conditions. The conclusive remarks of most of the studies were that curcumin has potent therapeutic effects against severe human pathologies including auto-immune disorders and metabolic diseases *via* modulation of molecular targets/ processes (Pandey *et al*., 2011; Singh *et al*., 2016; Kim and Clifton, 2018).

2.2 Anticancer property

Anticancer effect is one of the most explored biological properties of curcumin. This magical compound has been reported to be effective against colon, pancreas, breast, lung, blood, and liver cancer (Prasad *et al*., 2014; Barati *et al*., 2019). Clinical studies and human trials have documented the protective activity of curcumin against many phases of carcinogenesis; initiation, progression, invasion and metastasis (Anand *et al*., 2008; Barati *et al*., 2019).

Experimental evidence has shown that curcumin suppress growth of cancer cells *via* multiple pathways which may incorporate caspase activation, tumor suppression, death-receptor pathway, cell survival and modulation of various protein kinases including adenosine monophosphate-activated protein kinase (AMPK) (Kocaadam and Aanlier, 2017; Lyons and Roche, 2018). In addition to direct action on carcinogenesis, curcumin has been reported to improve the effectiveness of radiotherapy, thus enhances the chance of curability and survival (Akpolat *et al*., 2010).

2.3 Protection of cardiovascular diseases

Anti-inflammatory and antioxidant properties of curcumin enable it to be stand in the front queue of the herbal agents used in therapies of cardio-related vascular disorders. Curcumin has been documented to enhance the expression of heme oxygenase-1 (HO-1) by motivating Nrf2-dependent antioxidant response and to suppress tumor necrosis factor alpha (TNF-α) in smooth muscle cells and thus activates the expression of p21 mediated by HO-1 (Pae *et al*., 2007; Kocaadam and Aanlier, 2017). Over expression of JAK2/ STAT3 signal pathway is the mechanism by which curcumin has been found to prevent ischemia (Duan *et al*., 2012). Administration of curcumin has shown to lower the risk of development of coronary diseases by diminishing the serum triglyceride (TG), low-density lipoprotein (LDL) and very low-density lipoprotein (VLDL) cholesterol (Mirzabeigia *et al*., 2015). Hypertension and hyperlipidemia are reported as the other major culprits behind cardiac arrest; a diet rich in curcumin has been found to be protective against these biomarkers, thus lowers the threaten to life (Panahi *et al*., 2018).

2.4 Antidiabetes and antiobesity properties

Diabetes is a metabolic disorder which affects almost all the vital organs of the body. Functioning of brain, kidneys, liver, heart and eyes badly compromised in hyperglycemia (Tiwari *et al*., 2013; Nabavi *et al*., 2015). Adequate dose of curcumin has been documented to prevent the condition of hyperglycemia by multiple mechanisms and thus prevents the development of diabetes (Shehzad and Lee, 2010; Nabavi *et al*., 2015). Recent studies have shown that curcumin reduces sustained blood glucose level by increasing expression of various glucose transporters (GLUTs), decreasing glucose hepatic regeneration and increasing uptake of glucose by cells (Nabavi *et al*., 2015). Curcumin has also been reported to protect insulin resistance and enhance insulin sensitivity (Ghorbani *et al*., 2014). Induction of HO-1 gene and potent radical activities are also considered as important mechanisms by which curcumin prevents the complications associated with diabetes (Deogate and Ghate, 2015).

Curcumin has been found to be effective against obesity since its supplementation suppressed mitogen activated protein kinase (MAPK) and other kinases which are regulated by signals and are directly associated with cell differentiation and genesis of adipocytes (Ahn *et al*., 2010). Elevation in adiponectin expression due to treatment of curcumin promotes the antiobesity property of this yellow compound since adiponectin prevents genesis of obesity through suppressing NF-κB activity (Ahn *et al*., 2010; Nabavi *et al*., 2015).

2.5 Prevention of neuro-disorders and ageing

Time dependent degradation in activities and alertness is ageing which ultimately results in death. Ageing is scientifically considered as a disease (Pandey and Rizvi, 2010). Malfunctioned neuronal activities are the major reason to promote ageing and other associated pathologies. Studies have documented that curcumin possess the potential that could involve to prevent age associated events and to increase healthy life span (Sarker and Franks, 2018). Strong anti-oxidative, anti-inflammatory activities of curcumin are proposed to restore the protein homeostasis, suppress inflammation and gene mutations which are reported to play significant role in development and progression of neurodisorders, followed by ageing (Nabiuni *et al*., 2011; Sarker and Franks, 2018). Curcunin has been documented to improve cognitive functions through reducing deterioration of neurons and formation of α-amyloid plaques and microglia (Mishra and Palanivelu, 2008). It has also been reported that curcumin possesses remarkable protective effect against degradation of myelin sheath and maintaining dopamine levels in striatum (Tegenge *et al*., 2014).

2.6 Others

Besides described healing properties, use of curcumin is documented in therapy of many skin ailments such as dermatitis, scleroderma and psoriasis (Panahi *et al*., 2019). In traditional Indian medical system, use of curcumin to make the skin wrinkle-free and make it glow is one of the most frequent practices (Prasad *et al*., 2014). Scavenging the free radicals and prevention of inflammation by inhibiting NF-κB are the reported mechanisms by which curcumin may protect the skin from being damaged (Prasad *et al*., 2014; Panahi *et al*., 2019). Curative effects against gastric ulcers, induction of gastric juice, prevention against inflammatory bowel disease and improving digestion are the other reported healing effects of curcumin. In addition, curcumin has also been reported to be beneficial in asthma and other allergies (Shehzad and Lee, 2010). Agencies deputed for certification of food and drug have accepted curcumin as a generally recognized safe compound to administer for a good health (Kocaadam and Aanlier, 2017).

3. Garlic (*Allium sativum* L.)

Garlic (*Allium sativum* L.) is one of the most frequently used herbal spices in the kitchen. It is a bulbous herb having a powerful aroma and pungent taste. Garlic contains a variety of bioactive constituents including sulfur compounds such as alliin, allicin, ajoene, allylpropyl disulfide, diallyl disulfide (DADS), diallyltrisulfide (DATS), S-allylcysteine (SAC); peroxidases and alliniase like enzyme, amino acids and many important trace elements like Se, Ge and Te (Rana *et al*., 2011; Adaki *et al*., 2014). Interestingly quantity of sulfur compounds in garlic is higher than other *Allium* sps. (Amagase *et al*., 2001). There is evidence that excessive amount of sulfur compounds in garlic are mainly responsible for the pungent taste and therapeutic properties associated with consumption of garlic (Petropoulos *et al*., 2017).

The garlic constituents have shown a higher bioavailability which ranges from 10 min (alliin) to 120 min (vinyldithiins) in reaching peak serum concentration (Egen-Schwind *et al*., 1992). The persistence of these compounds is also better than other same species compounds; alliin persists for about 6 h whereas persistence of vinyldithiins is reported up to four days. Clinical and human trials have shown that garlic constituents are absorbed up to 98% when taken orally (Lachmann *et al*., 1994; Amagase *et al*., 2001; Rana *et al*., 2011).

3.1 Healing properties

Garlic has historically been used for treatment of many deleterious diseases and to promote good health. In many parts of the world, garlic is frequently used to treat aches and pains, leprosy, diarrhea, infections, dandruff, respiratory disorders, fatigue and blood pressure disorders (Adaki *et al*., 2014; Borlinghaus *et al*., 2014; Miraghajani *et al*., 2018). After demonstration of antiseptic property of garlic by Louise Pasteur in 1858, the scientific studies for exploration of its medicinal properties, extraction of bioactive compounds and development of remedy drugs of garlic origin gained the attention (Rana *et al*., 2011).

3.2 Protection of cardiovascular diseases

Cardiovascular protective effect is the most notable therapeutic property of garlic components. Human trials have documented that garlic prevents vascular disorders by means of managing lipid profile of blood, controlling blood pressures, inhibiting platelet aggregation and by modulating fibrinolytic activity (Adaki *et al*., 2014; Karagodin *et al*., 2016). Experimental studies have also reported that supplementation of garlic extract lowered the blood cholesterol level, improved blood circulation and, thus delayed the progression of atherosclerosis (Karagodin *et al*., 2016). There are reports that claim that consumption of garlic or a diet rich in garlic can reduce the plaque deposits in the arteries and, thus may provide a natural way to prevent angina and atherosclerosis (Borek , 2006).

Hypertension is one of the major factors involved behind development of many cardio-related disorders which affects the life in several ways (Li *et al*., 2013). Epidemiological and laboratory studies have proven that short term supplementation of garlic elicits protective effect in hypertensive patients; lowered the elevated levels of oxidative stressors and declined the systolic and diastolic blood pressures (Borek, 2006; Lee *et al*., 2013). Ingestion of garlic extract has also been showed the protective effect against biochemical alterations in patients with atherosclerosis (Campbell *et al*., 2001; Karagodin *et al*., 2016).

3.3 Anticancer property

Epidemiological studies have shown that supplementation of garlic reduced the development and progression of tumor and cancer. Garlic has been shown to be effective against colon, lung, stomach, skin and breast cancer (Adaki *et al*., 2014; Nicastro *et al*., 2015; Miraghajani *et al*., 2018). Garlic constituents have been found to influence enzymes of phase I and phase II which are involved in bioactivation as well as removal of carcinogens (Manson *et al*., 1997). Studies have also provided experimental evidence that organosulfides of garlic suppresses the NAD(P)H: quinoneoxi-doreductase, clyclooxygenase and lipooxigenase that account for lower incident of carcinogenesis (Roy and Kulkarni, 1999). Experimental study has shown that intra-peritoneal injection of DADS was effective in treatment of colon cancer in mice (Sundaram and Milner, 1996). Other major constituent of garlic; DATS has been found to prevent cell proliferation by inducing programmed cell death through over expression of extra cellular signal regulated kinase and inhibition of Bcl-2 protein (Xiao *et al*., 2004). The derivatives of garlic are found to be effective in cancer treatment since they modulate the mechanisms that involve in cancer development such as formation of DNA adduct, mutagenesis, cell proliferation, damage by reactive oxygen species (ROS), formation of new blood vessels and apoptosis and, thus establish garlic as one of the most potent herbal agent against most types of cancer (Nicastro *et al*.,2015; Miraghajani *et al*., 2018).

3.4 Immune promotive and antiageing effect

Recent data on therapeutic effects of garlic suggest that sulfur compounds and trace elements present in garlic including Se, have immune stimulating property which prevents the body from intra and extra cellular stressors and infections and, thus promotes healthy life-span (Rahman *et al*., 2003; Kim, 2016). Garlic has been reported to improve NK cells functions and restore the age-related cognitive behavior in AIDS patients (Lamm and Riggs, 2001). There are experimental evidence that garlic supplementation increases antibody production, lymphocyte proliferation and generation of cytokinins which are used in antitumor response (Adaki *et al*., 2014; Nicastro *et al*., 2015). Garlic has been shown to enhance serum antioxidant level by activating expression of inherent enzymatic defense systems such as glutathione peroxidase and superoxide dismutase (SOD) in dose dependent manner and to inhibit lipid peroxidation and inflammatory prostaglandins (Rahman *et al*., 2003; Capasso, 2013). The antioxidant potential of garlic was comparable to the established antioxidants such as ascorbic acid (Vitamin C) and α-tocopherol (Vitamin E); effect of 1 mg garlic was equivalent to 30 nmol vitamin C or 3.6 nmol vitamin E (Lewin and Popev, 1994).

3.5 Others

There are other health areas where garlic supplementation/injection has shown beneficial effects. Some antecedent studies have described antimicrobial properties of garlic and have shown that garlic can inhibit persistence yeast infections and may be useful in treating ear infections (Chung *et al*., 2007). In African countries, garlic is frequently used in treatment of dysentery (Peirce, 1999). In addition to the mentioned properties, garlic remedies are used to treat various respiratory tract infections, cough and cold and influenza (Abdullah, 2000). Irrespective to prevent/treat the diseases after their development, garlic or its extracts have also been used to improve overall health. Potential antioxidant, anti-inflammatory and radical scavenging properties of garlic establish it as health tonic of herbal origin. The fresh garlic sulfur compounds have shown higher antioxidant potential than aged garlic (Jeong *et al*., 2016).

4. Ginger (*Zingiber officinale* Roscoe)

Ginger (*Zingiber officinale* Roscoe) of family Zingiberaceae, is a perennial herb whose rhizome is used in culinary and medicinal purposes. Over a hundred compounds have been reported to be present in fresh rhizome of ginger including protein, fat, carbohydrate and essential oils (Zadeh and Kor, 2014). Ginger is rich in vitamins especially in B complexes, C and fiber content (Mashhadi *et al*., 2013). Besides this, ginger possesses several bioactive compounds such as gingerol, shogaol, paradol and zingerone, among which gingerol, biochemically denoted as [6]-gingerol is explored more for biological activities than others. Biochemical analysis of fresh rhizome of ginger have shown that mainly [6]-gingerol is involved in medicinal and therapeutic properties of ginger (Mashhadi *et al*., 2013; Zadeh and Kor, 2014; de Lima *et al*., 2018).

4.1 Healing properties

Over twenty five centuries, ginger has been used as a medicinal herb to treat many health disorders and promote good health (de Lima *et al*., 2018). Initially, it was used to treat nausea and to warm body in winter season but later on, it was used to prevent inflammatory diseases and pain (Ali *et al*., 2008). Recent studies and human trials have shown that ginger or ginger rich diets have potential to prevent the diseases and promote good health.

4.2 Anticancer property

Studies have provided significant evidence that ginger elicits potent anticancer and antitumor activities (Shukla and Singhm 2007; de Lima *et al*., 2018). Though, ginger has exhibited preventive properties against many types of cancer including ovarian, liver, skin, breast, and prostate cancer, but its effect against colon cancer is more remarkably described (Ishiguro *et al*., 2007; Hung *et al*., 2009; de Lima *et al*., 2018). Study performed to investigate the potency of ginger in prevention of development and progression of colon cancer has documented that treatment of ginger over expressed the inherent anti-oxidative systems (enzymatic) and diminished the development of cancer of colon which was induced by 1, 2 dimethylhydrazine (DMH) (Manju and Nalini, 2005). Advanced studies have reported that bioactive components of ginger perform anticancer activity *via* multiple mechanisms that include reduction in proliferation of cells, promotion of programmed cell death and by reduction in NF-κB and HO-1 expression (Ishiguro *et al*., 2007; Walczak *et al*., 2017). Activation of cascades of caspase proteins has been reported by [6]-gingerol and [6]-shogaol, the major bioactive constituent of ginger during prevention of gastric cancer (Shukla and Singh, 2007; Walczak *et al*., 2017).

Increased use of biopesticides, food preservatives and unethical contaminations in food products has increased the rate of development of gastro related cancer many folds in last some decades. Ginger has been reported to be significantly effective in prevention of development and progression of gastro-related cancer (Ishiguro *et al*., 2007). [6]-gingerol has been documented to prevent progression of hepatic cancer by arresting the cytogenesis and inducing programmed cell death (Yagihashi *et al*., 2008). Effect of ginger extract on inhibition of over expressed NF-κB and TNF-α in liver cancer has been reported (Habib *et al*., 2008). Same effect was observed in prevention of ovarian cancer in which along with reducing the expression of NF-κB, ginger supplementation suppressed the secretion of VEGF and IL-8 (Rhode *et al*., 2007).

In continuation, anticancer effect of ginger was also reported in treatment of skin myeloma. Bioconstituent of ginger; gingerol prohibited the proliferation of human epidermoid carcinoma cells (Nigam *et al*., 2009). There are experimental evidence that ginger has remarkable effect in prevention of pancreatic carcinoma cells, breast and prostate cancer *via* mediating the signaling pathways, activating protein caspases involved in programmed cell death and *via* inhibiting cell adhesion invasion motility (Mashhadi *et al*., 2013; Walczak, 2017; de Lima *et al*., 2018).

4.3 Cardiovascular protection

Ginger is reported to provide overall protection against cardio-related health disorders. Ginger has been reported to dilute the blood and to improve blood circulation *via* its stimulating effect of muscles of hearts (Kulczyñski and Gramza-Michasowska, 2016; Wang *et al*., 2017). Both the activities are described to stimulate the cellular metabolic events, thus contributing to the relief of cramps and reduce hypertension (Wang *et al*., 2017). Ginger has been reported as excellent anticoagulant which reduces the clotting ability of blood by inhibiting the formation of pro-inflammatory prostaglandins (PGE2) and thromboxane (TBX2) (Ezzat *et al*., 2018). Consumption of ginger has been reported to lower the cholesterol level in blood even after intake of fat rich diet (Kulczyñski and Gramza-Michasowska, 2016). Extract of ginger is found beneficial in lowering the blood pressure and relaxing blood vessels by mediating the blockade of calcium channels, thus reduces the chances of hypertension and stroke (Zadeh *et al*., 2014; Wang *et al*., 2017).

4.4 Prevention of ageing and induced complications

Ageing itself comes with informal invitation to various health complications. Unregulated generation of ROS, weaken defense systems and diminished plasma antioxidant potential damage various visceral vital organelles of the cells and make them malfunctioned (Pandey and Rizvi, 2010; Singh *et al*., 2016). Persistence condition of compromised state of cell physiology induces complications including hyperglycemia, kidney damage, neuro-complications and impaired cognitive function which ultimately result in ageing (Di Loreto and Murphy, 2015). Treatment of ginger has been reported to beneficial in most of the complications related with ageing and promoting the health (Hügel, 2015; Choi *et al*., 2018).

Plethora of reports available that claim that supplementation of ginger or ginger rich food significantly prevented oxidation of proteins and glutathione, peroxidation of lipids and activated the inherent antioxidant enzymes such as glutathione peroxidase, glutathione reductase, and glutathione S-transferase (Ahmed *et al*., 2008; Mashhadi *et al*., 2013). Ginger has elicited the activity to modulate the serum C-reactive protein levels and induction of SOD activities in renal problems to prevent the damage (Choi *et al*., 2017). Strong antioxidant and anti-inflammatory activities of ginger have been documented to involve in prevention of age induced complications (Mashhadi *et al*., 2013; Ezzat *et al*., 2018).

Experiments on induced diabetic rats have provided the evidence that ginger possesses the potency to regulate blood glucose level and improve lipid profile including managing LDL, VLDL, TG and HDL levels (Fuhrman *et al*., 2000; Bhandari *et al*., 2005). Besides this, supplementation of ginger has also been reported to stimulate the production, release and/or activity of insulin and lowered the body weight which is an important measure in prevention of development of hyperglycemia (Nammi *et al*., 2009; Heimes *et al*., 2009)

4.5 Prevention of gastrointestinal discomfort and others

Improving gastrointestinal process is the oldest documented healing property of ginger (Oso *et al*., 2013). A diet rich in ginger/ ginger extract has been reported to stimulate digestion by increasing absorption, relieving constipation and flatulence (Oso *et al*., 2013; Zadeh *et al*., 2014). Ginger is documented as a strong preventive agent against motion sickness like dimenhydrates; administration of approximately 1 g ginger was remarkably effective in prevention of nausea and vomiting (Langner *et al*., 1998; Zadeh *et al*., 2014).

Other therapeutic, property of ginger is its toxic effects on microbes. There are reporting that ginger has ability to inhibit the multiplication of bacteria of colon that cause fermentation of undigested food which triggers flatulence, a major cause of development of piles (Lohsiriwat *et al*., 2010). Ginger supplementation counteracts the growth of *Escherichia coli*, *Proteus* sps, *Staphylococci*, *Streptococci* and *Salmonella* spp (Eliopoulos, 2007; Zadeh *et al*., 2014). Ginger juice has been shown inhibitory action against different species of fungus which cause skin diseases (Eliopoulos, 2007; Haque and Jantan, 2017).

5. Conclusion

Herbs are a simple way to add flavor and nutrition to foods. Both *in vitro* and *in vivo* studies have confirmed the therapeutic properties of curcumin, garlic and ginger, however studies have so for been needed to be conduct to propose the precise recommendations of the reference doses that could guarantee the desired effects.

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References

Abdullah, T. (2000). A strategic call to utilize Echinacea-garlic in flu-cold seasons. J. Natl. Med. Assoc., **92**:48-51.

Adaki, S.; Adaki, R.; Shah, K. and Karagir, A. (2014). Garlic: Review of literature. Indian J. Cancer, **51**:577-581.

Ahmed, R.S.; Suke, S.G.; Seth, V.; Chakraborti, A.; Tripathi, A.K. and Banerjee, B.D. (2008). Protective effects of dietary ginger (*Zingiber officinales* Roscoe.) on lindane-induced oxidative stress in rats. Phytother. Res., **22**:902-906.

Ahn, J.; Lee, H.; Kim, S. and Ha, T. (2010). Curcumin-induced suppression of adipogenic differentiation is accompanied by activation of Wnt/ beta-catenin signaling. Am. J. Physiol. Cell. Physiol., **298**:1510-1516.

Akpolat, M.; Tarlada¸calý¸sýr, Y.; Uz, Y.; Metin, M. and Kýzýlay, G. (2010). Kansertedavisindecurcumininyeri.Yeni. Týp. Dergisi., **27**:142-147.

Ali, B.H.; Blunden, G.; Tanira, M.O. and Nemmar, A. (2008). Some phytochemical, pharmacological and toxicological properties of ginger (*Zingiber officinale* Roscoe): A review of recent research. Food Chem. Toxicol., **46**:409-420.

Amagase, H.; Petesch, L.B. and Matsuura, H. (2001). Intake of garlic and its bioactive compounds. J. Nutr., **31**:955S-962S.

Anand, P.; Sundaram, C.; Jhurani, S.; Kunnumakkara, A. B. and Aggarwal, B. B. (2008). Curcumin and cancer: An "old-age" disease with an "ageold" solution. Cancer Lett., **267**:133-164.

Barati, N.; Momtazi-Borojeni, A.A.; Majeed, M. and Sahebkar, A. (2019). Potential therapeutic effects of curcumin in gastric cancer. J. Cell Physiol., **234**:2317-2328.

Biradar, D.P.(2015). Medicinal plants and phytomedicines. Ann. Phytomed., **4**:1-5.

Bellamy, D. and Pfister, A. (1992). World Medicine: Plants, Patients and People. Blackwell Publishers Oxford, UK.

Bhandari, U.; Kanojia, R. and Pillai, K.K. (2005). Effect of ethanolic extract of *Zingiber officinale* on dyslipidaemia in diabetic rats. J. Ethnopharmacol., **97**:227-230.

Borek, C. (2006). Garlic reduces dementia and heart-disease risk. J. Nutr., **136**:810S-812S.

Borlinghaus, J.; Albrecht, F.; Gruhlke, M.C.; Nwachukwu, I.D. and Slusarenko, A.J. (2018). Allicin: Chemistry and biological properties. Molecules, **19**:12591-12618.

Campbell, J.H.; Efendy, J.L. and Smith, N.J. (2001). Molecular basis by which garlic suppresses atherosclerosis. J. Nutr., **131**;1006S-1009S.

Capasso, A. (2013). Antioxidant action and therapeutic efficacy of *Allium sativum* L. Molecules, **18**:690-700.

Choi, J.G.; Kim, S.Y.; Jeong, M. and Oh, M.S. (2018). Pharmacotherapeutic potential of ginger and its compounds in age-related neurological disorders. Pharmacol. Ther., **182**:56-69.

Chung, I.; Kwon, S.H. and Shim, S.T. (2007). Synergistic antiyeast activity of garlic oil and allyl alcohol derived from alliin in garlic. J. Food Sci., **72**:M437-M440.

de Lima, R.M.T.; Dos Reis, A.C. and de Menezes, A.P.M. (2018). Protective and therapeutic potential of ginger (*Zingiber officinale*) extract and [6]-gingerol in cancer: A comprehensive review. Phytother. Res., **32**:1885-1907.

Deogade, S. and Ghate, S. (2015). Curcumýn: Therapeutýc applýcatýons in systemýc and oral health. Int. J. Biol. Pharm. Res., **6**:281-290.

Devassy, J.; Nwachukwu, I. and Jones, P. (2015). Curcumin and cancer: Barriers to obtaining a health claim. Nutr. Rev., **73**:155-165.

DiLoreto, R. and Murphy, C.T. (2015). The cell biology of ageing. Mol. Biol. Cell., **26**:4524-4531.

Duan, W.; Yang, Y.; Yan, J.; Yu, S.; Liu, J. and Zhou, J. (2012). The effects of curcumin post-treatment against myocardial ischemia and reperfusion by activation of the JAK2/STAT3 signaling pathway. Basic Res. Cardiol., **107**:263.

Egen-Schwind, C.l.; Eckard, R. and Kemper, F.H. (1992). Metabolism of garlic constituents in the isolated perfused rat liver. Planta Med., **58**: 301-305.

Eliopoulos, C. (2007). Ginger: More than a great spice. Director, **15**: 46-47.

Ezzat, S.M.; Ezzat, M.I.; Okba, M.M.; Menze, E.T. and Abdel-Naim, A.B. (2018). The hidden mechanism beyond ginger (*Zingiber officinale* Roscoe) potent *in vivo* and *in vitro* anti-inflammatory activity. J. Ethno-Pharmacol., **214**:113-123.

Fuhrman, B.; Rosenblat, M.; Hayek, T.; Coleman, R. and Aviram, M. (2000). Ginger extract consumption reduces plasma cholesterol, inhibits LDL oxidation and attenuates development of atherosclerosis in atherosclerotic, apolipoprotein E-deficient mice. J. Nutr., **130**:1124-1231.

Ghorbani, Z.; Hekmatdoost, A. and Mirmiran, P. (2014). Antihyperglycemic and insulin sensitizer effects of turmeric and its principle constituent curcumin. Int. J. Endocrinol. Metab., **12**:e18081.

Goel, A.; Kunnumakkara, A. B. and Aggarwal, B. B. (2008). Curcumin as "curecumin": From kitchen to clinic. Biochem. Pharmacol., **75**:787-809.

Guldiken, B.; Ozkan, G.; Catalkaya, G.; Ceylan, F.D.; EkinYalcinkaya, I. and Capanoglu, E. (2018). Phytochemicals of herbs and spices: Health versus toxicological effects. Food Chem. Toxicol., **119**:37-49.

Habib, S.H.; Makpol, S.; Abdul Hamid, N.A.; Das, S.; Ngah, W.Z. and Yusof, Y.A. (2008). Ginger extract (*Zingiber officinale*) has anticancer and anti-inflammatory effects on ethionine-induced hepatoma rats. Clinics (Sao Paulo), **63**:807-813.

Haque, M.A. and Jantan, I. (2017). Recent Updates on the Phytochemistry, Pharmacological, and Toxicological Activities of *Zingiber zerumbet* (L.) Roscoe ex Sm. Curr. Pharm. Biotechnol., **18**:696-720.

Heimes, K.; Feistel, B. and Verspohl, E.J. (2009). Impact of the 5-HT receptor channel system for insulin secretion and interaction of ginger extracts. Eur. J. Pharmacol., **624**:58-65.

Hügel, H.M. (2015). Brain Food for Alzheimer-Free Ageing: Focus on Herbal Medicines. Adv. Exp. Med. Biol., **863**:95-116.

Hung, J.Y.; Hsu, Y.L.; Li, C.T.; Ko, Y.C.; Ni, W.C. and Huang, M.S. (2009). [6]-Shogaol, an active constituent of dietary ginger, induces autophagy by inhibiting the AKT/mTOR pathway in human non-small cell lung cancer A549 cells. J. Agric. Food Chem., **57**:9809-9816.

Ishiguro, K.; Ando, T.; Maeda, O.; Ohmiya, N.; Niwa, Y. and Kadomatsu, K. (2007). Ginger ingredients reduce viability of gastric cancer cells *via* distinct mechanisms. Biochem. Biophys. Res. Commun., **362**:218-223.

Jeong, Y.Y.; Ryu, J.H.; Shin, J.H.; Kang, M.J.; Kang, J.R.; Han, J. and Kang, D. (2016). Comparison of antioxidant and anti-inflammatory effects between fresh and aged black garlic extracts. Molecules, **21**:430.

Karagodin, V.P.; Sobenin, I.A. and Orekhov, A.N. (2016). Antiatherosclerotic and cardioprotective effects of time-released garlic powder pills. Curr. Pharm. Des., **22**:196-213.

Kim, H.K. (2016). Protective effect of garlic on cellular senescence in UVB-exposed HaCaT human keratinocytes. Nutrients., **8**:E464.

Kim, Y. and Clifton, P. (2018). Curcumin, cardiometabolic health and dementia. Int. J. Environ. Res. Public Health, **15**:E2093.

Kocaadam, B. and Aanlier, N. (2017). Curcumin, an active component of turmeric (*Curcuma longa*), and its effects on health. Crit. Rev. Food Sci. Nutr., **13**:2889-2895.

Kulczyñski, B. and Gramza-Michasowska, A. (2016). The importance of selected spices in cardiovascular diseases. Postepy. Hig. Med. Dosw. (Online).,**70**:1131-1141.

Lachmann, G.; Horenz, D. and Radeck, W. (1994). The pharmacokinetics of the S-35 labeled garlic constituents alliin, allicin and vinyldithiine. Arzeimitteforschung., **44**:734-743.

Lamm, D.L. and Riggs, D.R. (2001). Enhanced immunocompetence by garlic: Role in bladder cancer and other malignancies. J. Nutr., **131**:1067S-1070S.

Langner, E.; Greifenberg, S. and Gruenwald, J. (1998). Ginger: History and use. Adv. Ther., **15**:25-44.

Lewin, G. and Popev, I. (1994). Antioxidant effect of aqueous garlic extract. 2nd communication: Inhibition of the Cu (2þ)-initiated oxidation of low density lipoproteins. Arzneimettelforchung.,**44**:604-607.

Li, L.; Sun, T.; Tian, J.; Yang, K.; Yi, K. and Zhang, P. (2013). Garlic in clinical practice: An evidence-based overview. Crit. Rev. Food Sci. Nutr., **53**:670-681.

Lohsiriwat, S.; Rukkiat, M.; Chaikomin, R. and Leelakusolvong, S. (2010). Effect of ginger on lower esophageal sphincter pressure. J. Med. Assoc. Thai., **93**:366-372.

Lyons, C.L. and Roche, H.M. (2018). Nutritional Modulation of AMPK-Impact upon Metabolic-Inflammation. Int. J. Mo.l Sci., **19**:E3092.

Manju, V. and Nalini, N. (2005). Chemopreventive efficacy of ginger, a naturally occurring anticarcinogen during the initiation, post-initiation stages of 1, 2 dimethylhydrazine-induced colon cancer. Clin.Chim.Acta., **358**:60-67.

Manoharachary, C. and Nagaraju, D. (2016). Medicinal plants for human health and welfare. Ann. Phytomed., **5**:24-34.

Manson, M.M.; Ball, H.W. and Barrett, M.C. (1997). Mechanism of action of dietary chemoprotective agents in rat liver: Induction of phase I and II drug metabolizing enzymes and aflatoxin B1 metabolism. Carcinogenesis,**18**:1729-1738.

Mashhadi, N.S.; Ghiasvand, R.; Askari, G.; Hariri, M.; Darvishi, L. and Mofid, M.R. (2013). Antioxidative and anti-inflammatory effects of ginger in health and physical activity: Review of current evidence. Int. J. Prev. Med., **4**:S36-42.

Miraghajani, M.; Rafie, N.; Hajianfar, H.; Larijani, B. and Azadbakht, L. (2018). Aged garlic and cancer: A systematic review Int. J. Prev. Med., **9**:84.

Mirzabeigia, P.; Mohammadpour, A. H.; Salarifar, M.; Gholami, K.; Mojtahedzadeh, M. and Javadi, M. R. (2015). The effect of curcumin on some of traditional and nontraditional cardiovascular risk factors: A pilot randomized, double-blind, placebo-controlled trial. Iran. J. Pharm. Res., **14**:479-486.

Mishra, S. and Palanivelu, K. (2008). The effect of curcumin (turmeric) on Alzheimer's disease: An overview. Ann. Indian Acad. Neurol., **11**:13-19.

Moghadamtousi, S.Z.; Kadir, H.A.; Hassandarvish, P.; Tajik, H.; Abubakar, S. and Zandi, K. (2014). A review on antibacterial, antiviral, and antifungal activity of curcumin. Biomed. Res. Int., pp:186-864.

Mohammed, A.; Pandey, K.B. and Rizvi, S.I. (2017). Effect of phytochemicals on diabetes-related neurological disorders, In: Effects of Phytochemicals in Neurological Disorders, Wiley-Blackwell Publishers, USA, pp:283-298.

Nabavi, S.F.; Thiagarajan, R.; Rastrelli, L.; Daglia, M.; Sobarzo-Sánchez, E.; Alinezhad, H. and Nabavi, S.M. (2015). Curcumin: A natural product for diabetes and its complications. Curr. Top. Med. Chem., **15**:2445-2455.

Nabiuni, M.; Nazari, Z.; AbdolhamidAngaji, S. and Nejad, S. (2011). Neuroprotective effects of curcumin. Aust. J. Basic Appl. Sci., **5**:2224-2240.

Nammi, S.; Sreemantula, S. and Roufogalis, B.D. (2009). Protective effects of ethanolic extract of *Zingiber officinale* rhizome on the development of metabolic syndrome in high-fat diet-fed rats. Basic Clin.Pharmacol.Toxicol., **104**:366-373.

Nicastro, H.L.; Ross, S.A. and Milner, J.A. (2015). Garlic and onions: Their cancer prevention properties. Cancer Prev. Res. (Phila)., **8**:181-189.

Nigam, N.; Bhui, K.; Prasad, S.; George, J. and Shukla, Y. (2009). [6]-Gingerol induces reactive oxygen species regulated mitochondrial cell death pathway in human epidermoid carcinoma A431 cells. Chem. Biol. Interact., **181**:77-84.

Oso, A.O.; Awe, A.W.; Awosoga, F.G.; Bello, F.A.; Akinfenwa, T.A. and Ogunremi, E.B. (2013). Effect of ginger (*Zingiber officinale* Roscoe) on growth performance, nutrient digestibility, serum metabolites, gut morphology, and microflora of growing guinea fowl. Trop. Anim. Health Prod., **45**:1763-1769.

Owen, L. and Corfe, B. (2017). The role of diet and nutrition on mental health and wellbeing. Proc. Nutr. Soc., **76**:425-426.

Pae, O.; Jeong, S.; Jeong, O.; Kim, S. and Kim, A. (2007). Roles of heme oxygenase-1 in curcumin-induced growth inhibition in rat smooth muscle cells. Exp. Mol. Med., **39**:267-277.

Panahi, Y.; Ahmadi, Y.; Teymouri, M.; Johnston, T.P. and Sahebkar, A. (2018). Curcumin as a potential candidate for treating hyperlipidemia: A review of cellular and metabolic mechanisms. J. Cell Physiol., **233**:141-152.

Panahi, Y.; Fazlolahzadeh, O.; Atkin, S.L.; Majeed, M.; Butler, A.E.; Johnston, T.P. and Sahebkar, A. (2019). Evidence of curcumin and curcumin analogue effects in skin diseases: A narrative review. J. Cell Physiol., **234**:1165-1178.

Pandey, A.; Pandey, K.B.; Gupta, R.K. and Rizvi, S.I. (2011). Ferric reducing, antiradical and beta-carotene bleaching activities of nicotinic acid and picolinic acid bioconjugates of curcumin. Nat. Prod. Commun., **6**:1877-1880.

Pandey, K.B. (2017). Mediterranean diet and its impact on cognitive functions in aging, In: Role of the Mediterranean Diet in the Brain and Neurodegenerative Diseases, Elsevier BV/Ltd/Inc (USA), pp:157-170.

Pandey, K.B. and Rizvi, S.I. (2009). Plant polyphenols as dietary antioxidants in human health and disease. Oxid. Med. Cell. Longev., **2**:270-227.

Pandey, K.B. and Rizvi, S.I. (2010). Markers of oxidative stress in erythrocytes and plasma during ageing in humans. Oxid. Med. Cell. Longev., **3**:2-12.

Peirce, A. (1999). The ABC Clinical Guide to Herbs: The American Pharmaceutical Association Practical Guide to Natural Medicines. New York: William Morrow and Company, Inc.

Petropoulos, S.; Di Gioia, F. and Ntatsi, G. (2017). Vegetable organosulfur compounds and their health promoting effects. Curr. Pharm. Des., **23**:2850-2875.

Prasad, S.; Gupta, S.; Tyagi, A. and Aggarwal, B. (2014). Curcumin, a component of golden spice: From bedside to bench and back. Biotechnol. Adv., **32**:1053-1064.

Raisuddin, S.; Ahmad, S.; Fatima, M. and Dabeer, S. (2018). Toxicity of anticancer drugs and its prevention with special reference to role of garlic constituents. Ann. Phytomed., **7**:13-26.

Rajeshwari, C.U.; Shobha, R.I. and Andallu, B. (2014). Phytochemicals in diet and human health with special reference to polyphenols. Ann. Phytomed., **3**:4-25.

Rahman, K. (2003). Garlic and ageing: New insights into an old remedy. Ageing Res. Rev., **2**:39-56.

Rakhi, N.K.; Tuwani, R.; Mukherjee, J. and Bagler, G. (2018). Data-driven analysis of biomedical literature suggests broad-spectrum benefits of culinary herbs and spices. PLoS One, **13**:e0198030.

Rakotoarisoa, M. and Angelova, A. (2018). Amphiphilic nanocarrier systems for curcumin delivery in neurodegenerative disorders. Medicines (Basel), **5**:E126.

Rana, S.V,; Pal, R.; Vaiphei, K.; Sharma, S.K. and Ola, R.P. (2011). Garlic in health and disease. Nutr. Res. Rev., **24**:60-71.

Rhode, J.; Fogoros, S.; Zick, S.; Wahl, H.; Griffith, K.A. and Huang, J. (2007). Ginger inhibits cell growth and modulates angiogenic factors in ovarian cancer cells. BMC Complement. Altern. Med., **7**:44.

Roy, P. and Kulkarni, A.P. (1999). Co-oxidation of acrylonitrile by soybean lipoxygenase and partially purified human lung lipoxygenase. Xenobiotica., **29**:511-531.

Sarker, M.R. and Franks, S.F. (2018). Efficacy of curcumin for age-associated cognitive decline: A narrative review of preclinical and clinical studies. Geroscience, **40**:73-95.

Shehzad, A. and Lee, Y. S. (2010). Curcumin: Multiple molecular targets mediate multiple pharmacological actions - A review. Drugs Fut., **35**:113-119.

Shukla, Y. and Singh, M. (2007). Cancer preventive properties of ginger: A brief review. Food Chem. Toxicol., **45**:683-690.

Singh, S.; Pandey, K.B. and Rizvi, S.I. (2016). Erythrocyte senescence and membrane transporters in young and old rats. Arch. Physiol. Biochem., **122**:228-234.

Singh, P.; Pandey, K.B. and Rizvi, S.I. (2016). Curcumin: The yellow molecule with pleiotropic biological effects. Lett.Drug Des.Discov., **13**:170-177.

Singh, R.K.; Pandey, K.B. and Rizvi, S.I. (2012). Medicinal properties of some Indian spices. Ann. Phytomed., **1**:29-33.

Sundaram, S.G. and Milner, J.A. (1996). Diallyl disulfide suppresses the growth of human colon tumor cell xenografts in athymic nude mice. J. Nutr., **126**:1355-1361.

Tegenge, M. A.; Rajbhandari, L.; Shrestha, S.; Mithal, A.; Hosmane, S. and Venkatesan, A. (2014). Curcumin protects axons from degeneration in the setting of local neuroinflammation. Exp. Neurol., **253C**:102-110.

Tiwari, B.K.; Pandey, K.B.; Abidi, A.B. and Rizvi, S.I. (2013). Markers of Oxidative Stress during Diabetes Mellitus. J. Biomark., **3**:787-790.

Viuda-Martos, M.; Ruiz-Navajas, Y.; Fernández-López, J. and Pérez-Álvarez, J.A. (2010). Spices as Functional Foods. Crit. Rev. Food Sci. Nutr., **51**: 13-28.

Walczak, K.; Marciniak, S. and Rajtar, G. (2017). Cancer chemoprevention - selected molecular mechanisms. Postepy. Hig. Med. Dosw. (Online).,**71**:149-161.

Wang, Y.; Yu, H.; Zhang, X. and Feng, Q. (2017). Evaluation of daily ginger consumption for the prevention of chronic diseases in adults: A cross-sectional study.Nutrition, **36**:79-84.

Xiao, D.; Choi, S.; Johnson, D.E.; Vogel, V.G. and Johnson, C.S. (2004). Diallyltrisulfide induced apoptosis in human prostate cancer cells involves c Jun N terminal kinase and extracellular signal regulated kinase mediated phosphorylation of Bcl 2. Oncogene, **23**:5594-5606.

Yagihashi, S.; Miura, Y. and Yagasaki, K. (2008). Inhibitory effect of gingerol on the proliferation and invasion of hepatoma cells in culture. Cytotechnology, **57**:129-136.

Yashin, A.; Yashin, Y.; Xia, X. and Nemzer, B. (2017). Antioxidant activity of spices and their impact on human health: A review. Antioxidants (Basel), **6**:E70.

Zadeh, J.B. and Kor, N.M. (2014). Physiological and pharmaceutical effects of Ginger (*Zingiber officinale* Roscoe) as a valuable medicinal plant. Eur. J. Exp. Biol., **4**:87-90.