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Role of Garlic and Ginger in Anti-oxidative and Anti-inflammatory Effects in Aging

Radha Arulkumar[1], EunJin Bang[2], Sang-Gyun Noh[1], Takako Yokozawa[3], Hae Young Chung[1,2*]

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Mini review

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1. Interdisciplinary Research Program of Bioinformatics and Longevity Science, Pusan National University, 2, Busandaehak-ro 63 beon-gil, Geumjeong-gu, Busan, 46241, Republic of Korea
2. Department of Pharmacy, College of Pharmacy, Pusan National University, 2, Busandaehak-ro 63beon-gil, Geumjeong-gu, Busan, 46241, Republic of Korea
3. Graduate School of Science and Engineering for Research, University of Toyama, Toyama 930-8555, Japan

CORRESPONDENCE AUTHOR

Hae Young Chung, Ph.D. Telephone: 82-51-510-2814; Fax: 82-51-518-2821
E-mail: hyjung@pusan.ac.kr

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ABSTRACT

Aging is deterioration of the physiological functions in human body, which is associated with several diseases, such as cardiovascular disease, neurological disease, cancer, and other metabolic disorders. It has been reported that oxidative stress and inflammation mainly contribute to the progression of aging. Hence, depletion of reactive oxygen species (ROS) and protective effect against inflammation could be the main strategies to extend lifespan of human beings. Due to side effects of drugs, recent researches focus on herbal medicines over the last two decades. Garlic (*Allium sativum*) and ginger (*Zingiber officinale Roscoe*) are the most commonly used dietary seasoning in the world. Previous studies show that garlic lowers blood pressure, cholesterol, triglycerides, homocysteine, boost immunity and decreases oxidative stress and inflammation, which are associated with anti-aging mechanism. Moreover, ginger and its bioactive compounds have shown the suppression of lipid peroxidation and recovered the levels of glutathione (GSH). In addition, ginger has shown the anti-inflammatory effect by decreasing nuclear factor of kappa light polypeptide gene enhancer in B-cells inhibitor, alpha (IκBα) degradation and impairing nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB) nuclear translocation of p65. Scientific evidences suggest that garlic and ginger both showed the protective effects against oxidative stress by depleting ROS and inflammation and extending life span. In this review, we discuss active components of garlic and ginger, and their biological roles in anti-aging, anti-oxidative and anti-inflammatory effects.

Keywords: Garlic, Ginger, Anti-oxidative, Anti-inflammatory, Anti-aging.

INTRODUCTION

Over the past two decades, natural compounds are gaining attention due to its health benefits without adverse effect. Particularly, recent researchers have focused on compounds that can extend lifespan of human being. Aging is deterioration of the physiological functions in human body, which is related to several diseases, such as arthritis, osteoporosis, cardiovascular diseases, cancer, metabolic disorders and Alzheimer's disease [1, 2]. Oxidative stress and inflammation are two critical factors that mainly contributes to the progression of aging [3]. Advanced aging process shares oxidative stress and chronic inflammation as one of causative pathological conditions. The cumulative oxidative stress and low -grade chronic inflammation are associated with natural aging process, in which modulation of these two responses could delay aging process and prevent age-related diseases. Hence, finding antioxidants could be a strategy in the field of developing drugs for delaying aging process. In this context, garlic and ginger both showed antioxidative and anti-inflammatory activities.

Garlic *(Allium sativum*, Liliaceae) is originated from Central Asia, which is used as medicinal plant for thousands of years. It has been used to cure common cold, treat ailments ranging from cardiovascular diseases to cancer and heal infections, even the plague. Garlic constitutes rich contents of volatile sulfur compounds like thiosulfates, which provide pungent aroma and give beneficial effects [4, 5]. Scientific research indicates that kyolic (aged garlic extract) is highly rich in antioxidants [6, 7], better than fresh garlic, without causing stomach allergy. Among herbal remedies, garlic is most commonly used, and consumed in the world.

Ginger *(Zingiber officinale Roscoe)* is one of the essential dietary products that have been used for the treatment of numerous ailments such as hypertension, migraines, arthritis, nausea and colds. Recently, interest has increased in ginger and its active components as therapeutic agents. Other than its anti-oxidative, anti-inflammatory, and anti-carcinogenic activities, it also has lifespan-extending property [8-11]. Hence, this paper attempts to review the current knowledge of biologically available natural active components of garlic and ginger and their physiological roles against aging process.

Aging and oxidative stress

Aging is the progressive decline of systemic functions, which is related to several diseases, such as heart disease, Alzheimer's disease, arthritis, cancer, osteoporosis, and metabolic disorders [1, 2]. Aging is influenced by genetic factors such as modulated metabolic processes, mutations, and environmental factors including diet and lifestyle which influence human genetic motifs. The incidence rates are increasing with aging which is approximated 100,000 cases of age-related deaths occurring daily, and the deaths caused by aging reaches 90%, especially in developed countries [12]. Even though evidence suggests that aging is caused by lipids peroxidation and DNA damage, exact mechanism is still unclear. It has been believed that single-celled organisms like *Caenorhabditis elegans* and mam-

mals share a common mechanism, called free radical theory, in which free radicals induce oxidative damage that becomes leading cause of aging [13, 14] by reactive oxygen species (ROS). Free radicals are the major contributor to the progression of aging [1, 15] ROS increase under pathological conditions such as infection, inflammation and stress, and in exposure to causative sources like NOx pollutants, smoking, radiation, and drugs like acetaminophen and even the sunlight [16]. Oxidative damage by ROS accumulates with human body as age increases. Moreover, garlic and ginger are reported to have many bioactive compounds that are exert antioxidant and anti-inflammatory effects.

Aging and inflammation

A chronic pro-inflammatory status is one of the common features of aging. This chronic low-grade inflammation also called as "inflammaging". Chronic inflammation is associated with several age-related diseases such as hypertension, diabetes, atherosclerosis, and cancer [17]. The elevated levels of inflammatory cytokines such as interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α) were found in aged population, which may induce tissue damage and aging [18]. In older people, low-grade inflammation occurs persistently which leads to degeneration of several organs. It has been demonstrated that cytokine-associated inflammation plays a crucial role in the aberrant behavior of maternal immune activation (MIA) offspring [19]. Moreover, peripheral blood inflammatory biomarkers such as several inflammatory cytokines, such as interleukin (IL)-1β, tumor necrosis factor (TNF)-α and interleukin (IL-6) are reported to increase in patients who suffered from the major depressive disorder [20]. Hence, recent studies attempt to improve therapeutics by regulating or blocking effects of the multi-source of inflammaging.

Garlic

Garlic (*Allium sativum*, Liliaceae) is one of the seasoning foods as well as therapeutic plants which is originated from Asia's central part. Garlic contains higher concentration of volatile sulfur compounds like thiosulfates, which gives pungent aroma and responsible for beneficial effects [4, 5]. Garlic consist of 65% water, 28% carbohydrate (fructans), 2.3% organosulfur compounds, 2% proteins (allinase), 1.2% free amino acid (arginine) and 1.5% fiber [21]. Mainly, allicin (diallylthiosulfate) is the active compound in garlic that gives pungent smell and its physiological properties [22]. Moreover, gamma-glutamyl-s-allyl-cysteine and S-allyl-L-cysteine sulfoxides (alliin) are the major sulfur-containing compounds present in garlic. These compounds act as precursors for many other active compounds.

Anti-aging properties of garlic

There is more samples of evidence reported that, the health benefits such as anti-aging and antioxidant effects of garlic [4, 5]. As previously mentioned, garlic is abundant in antioxidants and organosulfur compounds, which is responsible for its health benefits. It has been shown to prevent chronic diseases such as aging, cardiovascular diseases, cancer, and Alzheimer's dis-

ease. Some researchers suggest that eating kyolic is more effective than having fresh garlic [6, 7]; however, it's still in controversy. This aged garlic is an odorless, highly standardized supplement, which is enriched in its antioxidant such as S-allyl cysteine, which is water-soluble and highly bioavailable [6, 7]. Moreover, Garlic has been demonstrated for lowering cholesterol, triglycerides, and homocysteine, and decreasing oxidative stress and inflammation [4]. In addition, garlic treatment was reported to lower blood pressure, boost immunity, increase internal antioxidant like glutathione, and ameliorate fatigue. These reports suggest that garlic rich diet and its supplement in any form provides regular health benefits and help to prevent serious diseases and aging.

Anti-inflammatory effects of garlic

It is well known that the major transcription factor plays a main role in inflammatory process is nuclear factor kappa-B (NF-kB). Garlic juice exerts anti-inflammatory effect by suppressing oxidative stress with lead to activation of NF-kB that involved in activation of pro-inflammatory enzymes such as iNOS and cyclooxygenase-II expression [23]. Previous studies reported that allicin (main active compound) exerts an inhibitory effect on NF-kB activation thereby prevents from liver damage [24]. By inhibiting inflammatory cytokines and T-helper-1 [25], garlic extract showed the protective effect against inflammatory bowel disease associated with inflammation. Chronic inflammatory diseases like inflammatory bowel disease could be treated with Allicin treatment. Clinically, kyolic supplementation helps to improve NK cell activity in cancer patients [26].

Ginger

Zingiber officinale Roscoe, Zingiberaceae, is one of regularly eat up spice and also used as traditional herbal medicine for thousands of years [27]. Ginger root is the most commonly used for home remedies like headache, nausea, common cold and emesis. It possesses various life activities, such as antioxidant, anti-microbial, anti-inflammatory, anti-cancer activities [28]. Adding evidence to that ginger has also been reported to inhibit and regulate several diseases, such as neurodegenerative diseases, heart diseases and metabolic disorders like diabetes mellitus and obesity, and respiratory disorders [28]. Most abundant compounds in ginger are phenolic and terpene compounds [29]. The main phenolic compounds are gingerols, 6-shogaols, and 6-paradols that have been reported to have various biological activities. The major polyphenols identified in the fresh ginger are gingerols (6-gingerol, 8-gingerol, and 10-gingerol) [28, 29]. In addition, quercetin, zingerone, gingerenone-A, and 6-dehydrogingerdione were also other phenolic compounds reported in ginger. Also, terpene components are found in ginger essential oils such as β-bisabolene, α-curcumene, zingiberene, α-farnesene, and β-sesquiphellandrene. Apart from that organic acid, polysaccharides, lipids, and fresh fibers are also reported in ginger.

Anti-aging properties of ginger

The main health benefit of ginger is anti-

oxidative properties; hence oxidative stress correlate with several disorders; It has been also reported that ginger's anti-aging mechanism of action is related to antioxidant effects [30]. There are many studies demonstrated that ginger suppresses lipid peroxidation and recovered levels of GSH [31, 32] Under stress conditions, nitric oxide (NO) is produced by inducible nitric oxide synthase (iNOS) that influence signal transduction and finally contributes to disease progression. The previous study indicates that [6]-gingerol significantly inhibit production of NO and reduction of iNOS in LPS-stimulated mouse macrophages [8]. Also, [6]-gingerol also effectually reduced peroxynitrite-mediated oxidative stress-induced cell damage [8]. In addition, [6]-gingerol pre-treatment inhibited ultraviolet B (UVB) induced oxidative stress and further activated the Fas expression and caspase cascades [33]. Other compounds of Ginger such as 1-dehydro-[10]-gingerdione, and [6]-shogaol were reported to decrease LPS-induced NO production, and effectively reduce iNOS expression [34]. Moreover, [10]-gingerdione exhibited to decrease only LPS-induced NO production. Despite Ginger compounds showed anti-oxidative effects, cellular targets and exact molecular mechanisms are still unclear. Further studies are required to examine whether corporal activity occurs in humans.

Anti-inflammatory properties of ginger

Ginger is most commonly used in home remedy because it helps to reduce inflammation, swelling, and pain. It has been demonstrated that ginger juice cut off the suppressed T-cell activation, macrophage activation and also APC function [35]. One of main active compounds, [6]-gingerol and dried ginger extract both were showed anti-inflammatory effects [36]. [6]-gingerol, the stable metabolite was shown to overcome LPS-induced NO production in murine macrophages [37]. In addition, [6]-gingerol was shown to prohibit the production of pro-inflammatory cytokines such as TNF-α, IL-12 from LPS-stimulated peritoneal macrophages and interleukin (IL)-1β [38]. Gingerols was reported to inhibit arachidonate 5-lipoxygenase, an enzyme of leukotriene biosynthesis [39]. Generally, cyclooxygenase-2 (COX-2) is induced during inflammation to increase formation of prostaglandins. Only [8]-gingerol, no other compounds from ginger was significantly inhibited COX-2 expression [40]. Few studies have also shown that ginger extract suppresses the activation of TNF-α and expression of COX-2 in human synoviocytes [41]. Apart from that, ginger has shown to exhibit anti-inflammatory effect by decreasing IκBα degradation and impaired NF-κB nuclear translocation of p65 [37]. Most of the studies indicate that ginger and its active compounds have anti-inflammatory effects of both *in vitro* and *in vivo*.

CONCLUSIONS

Garlic is commonly used to treating colds, infections, and various diseases including cancer; Ginger is used to treat colds, nausea, arthritis and hypertension. Scientific evidences suggesting that garlic and ginger both showed protective effects against oxidative stress by depleting ROS, inflammation, which are critical risk factors for aging and age-related diseases leading to in-

crease in life span. Moreover, garlic and ginger are exhibiting different biological and medicinal properties, including anti-aging effects. Most importantly, these dietary condiments are commercially available at a reasonable price; so, it's easy to be used as alternative medicine. But still, the dosage of garlic and ginger should be standardizing to increase the effectiveness.

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