Phytochemicals Boost Anti-inflammatory Effect Against Gamma Radiation: Activities of Ginger and Coriander Extracts

H.S. Abd El-Salam¹ and A. A. Hassan²

¹Aromatic and Medicinal Plant Research, Dept., Horticulture Research Institute, Agriculture Research Center, Giza, Egypt
²Radiation Biology Dept., National Center for Radiation Research and Technology, Atomic Energy Authority, Cairo, Egypt

Received: 1/3/2016 Accepted: 5/6/2016

ABSTRACT

Phytochemicals are known to modulate immune function, and possess antitumor and antimicrobial properties. The present study is conducted to evaluate the cytotoxic effect of ginger and coriander extracts against tumor cells (MTT), anti-fungal and antioxidant activities of Ginger rhizome (Zingiber officinale) and Coriander (Coriandrum sativum) seed were evaluated. Essential oil of both plants showed 100% inhibition against Alternaria Alternata pathogen. The antioxidant activity showed the highest activities for ginger (methanol extract), whereas the lowest activity was for Coriander (water extract). To study the antioxidant and radio-protective effect of Ginger and Coriander, Swiss albino mice were exposed to shot dose 4Gy γ radiation after 14 days oral administration of ginger (100mg/Kg b.wt) and coriander extracts (600 mg/kg b.wt). After irradiation, anti-inflammatory mediators and phospholipase A2 were examined. In conclusion, Ginger and Coriander showed significant antioxidant and radio-protective effects.

Keywords: Coriander (Coriandrum sativum) / Ginger (Zingiber officinale) / γ radiation/ Antioxidant activity/ TNF-α, Cox-2, IL1β , IL6, and sPLA2

INTRODUCTION

In the last few years, there had been an exponential growth in the field of herbal medicine which are gaining popularity both in developing and developed countries because of their natural origin and less side effects. The use of preparations of these plants to treat diseases and improve the immunological response of the body has been practiced worldwide for centuries, but their effectiveness must be scientifically validated to increase the seriousness of their use(1,2).

Ginger (Zingiber officinale Rosc) is a natural dietary component belongs to Zingiberaceae family, with antioxidant and anti-carcinogenic properties(3). It has long been used in traditional medicine as a cure for some diseases including inflammatory diseases, blood sugar and fat loss (4). Ginger contains active phenolic compounds such as gingerol, paradol and shogoal that have antioxidant and anti-cancer activities (5).

Coriandrum sativum L. (C. sativum) which belongs to the family Apiaceae is a herb that is widely consumed globally and has purported health benefits ranging from antibacterial to antancer activities(6). It has traditionally been referred to as antidiabetic (7), anti-inflammatory and cholesterol lowering (8). The seeds of C. sativum contain 0.5-1 % essential oil and are rich in beneficial phytoneutrients including carvone, geraniol, limonene, borneol, camphor, elemol and finalool. Coriander’s flavonoids include quercitin, kaempferol, rhamnetin and epigenin. It also contains active phenolic acid compounds including caffeic and chlorogenic acid. Research also suggests that the volatile oils found in the leaves may have antimicrobial properties (9).
Ionizing radiation is a form of radiation with sufficient energy to remove electrons from their atomic or molecular orbital shells in the tissues they penetrate \(^{(10)}\). These ionizations, received in sufficient quantities over a period of time, can result in tissue damage and disturbance of cellular function at the molecular level. Ionizing radiation may break the cell’s DNA to the point that normal cell functions are markedly decreased or stopped, resulting in cell injury and death. Once damaged, the cell can either repair the damage or die. Repair or mis-repair may or may not result in cell lethality\(^{(11-12)}\).

The production of free radicals is a continuous process in the cells not only as products of normal metabolism but also as a result of exposure to environmental factors and toxins metabolism. When the endogenous antioxidant capacity is overcome by the excessive free radicals, an imbalanced state is perceived, which defined as oxidative stress\(^{(11-12)}\).

The process of inflammation is acute and self-limiting and has evolved to protect the body from various injurious stimuli, including pathogens, irritants, and damaged cells. Its main role is to prevent irreversible host tissue damage by quickly eliminating noxious stimuli and to subsequently initiate the return of the involved tissue(s) to homeostasis. Inflammation can, however, be a double-edged sword, as an excessive and uncontrolled inflammatory response can itself result in injury to host tissues \(^{(13)}\).

To inhibit the dangerous effects of the free radicals, it is advisable to use a diet rich in antioxidants. Therefore, it is very important to study and evaluate the content of antioxidants in different natural plant sources (such as Ginger and Coriander) which is the aim of the present study.

**MATERIALS AND METHODS**

**Reagents and Culture Media**

All chemicals utilized in the present investigation were of analytical grade and purchased from Sigma Chemical Company, St. Louis, U.S.A.

**Microorganism**

*Alternaria alternata* was obtained from MERCN of Faculty of Agriculture, Ain Shams University, Egypt.

**Preparation of Plant Extracts**

Ginger rhizome (*Zingiber officinale*) and Coriander seed (*Coriandrum sativum*) were obtained from Medicinal and Aromatic plant research Department, Horticulture Research Institute, Agriculture Research Center, Giza, Egypt. The dried plants were cleaned and washed. The extraction of active constituents was carried out using different successive solvents. These solvents were n-hexane, methanol and water. The cold extract was obtained by dipping dry matter in solvent. Extracts were filtered and stored at \(-4\) C for further analysis. After the evaporation of the used solvent, the extracts were subjected to further analysis.

**Analytical examination of plants constituents**

**Determination of Total Carbohydrates**

Total Carbohydrate was estimated according to Smith *et al.*\(^{(14)}\)

**Determination of Crude Protein and crude fiber**

Crude protein percentage was determined by using kjeldahl method described in the A.O.A.C.\(^{(15)}\)

**Determination of Total Phenols**

Total phenols were determined using Folin-Denis reagent according to Swain and Hillis \(^{(16)}\)
Determination of Flavonoids

Total flavonoids content was determined according to the reported colorimetric method by Zhuang et al.\(^{(17)}\).

Determination of Antioxidant Activity in Plants

Antioxidant activities were determined according to Chen et al.\(^{(18)}\).

Extraction of Essential Oils

Essential oils of ginger and coriander were separated by hydro-distillation according to Guenther\(^{(19)}\). The pure volatile oil was injected in Gas Chromatograph Mass Spectrometer (GC-MS) model Schimadzu QP-5000 to identify its constituents.

Fractionation of Flavonoids

Extracts of ginger and coriander were dissolved in 50% methanol and analyzed using reverse-phase HPLC with a phenyl column according to.\(^{(19)}\)

Ehrlich Ascites Carcinoma Cell Line (EAC)

Ehrlich Ascites Carcinoma, which is a fibroblast –like in shape\(^{(21)}\), was obtained from National Cancer Institute (NCI), Cairo University. Ehrlich Ascites Carcinoma cell line (EAC) was maintained by serial intraperitoneal transplantation as ascites from the peritoneal cavity in female Swiss albino mice. EAC cells were cultured in RPMI 1640 medium containing 10% heat inactivated fetal bovine serum (FBS), 100g/mL streptomycin and 100 U/mL penicillin G in a humidified atmosphere of 5% CO\(_2\) in air at 37 °C.

Animals

Female outbred Swiss albino mice originally obtained from National Cancer Institute (NCI) (20-25g) were used as experimental animals throughout the experiment period. The animals were housed under appropriate conditions of temperature and humidity and fed a balanced diet with free access to water ad libitum. Animal experimentations were consistent with the guidelines of ethics by Public Health Guide for the Care and Use of Laboratory Animals (National Research Council, 1996) in accordance to the recommendations for the proper care and use of laboratory animals approved by Animal Care Committee of the National Center for Radiation Research and Technology (NCRRT), Cairo, Egypt.

Experimental design

Mice were divided into 6 equal groups(15 mice/group) as follows: (1) control untreated group (C), (2) Irradiated group (R): animals were exposed to 4 Gy γ- radiation as a single shot dose at 14\(^{th}\) day post extract supplementation , (3): Coriander administered group (CO):animals were administered orally with a cumulative dose of hexane extracted coriander (600 mg/ Kg b.wt. for 14 days) diluted in 0.4 ml distilled water,(4): Ginger administered group (G):animals received orally 100mg/Kg b.wt hexane extracted ginger for 14 days,(5): Coriander irradiated group (COR): animals administered orally the coriander, then after 30 min of the last dose of coriander, the animals were exposed to 4 Gy whole body γ- irradiation as a shot dose. (6)Ginger irradiated group(GR): animals administered orally the ginger, then after 30 min of the last dose of ginger the animals were exposed to 4 Gy whole body γ- irradiation as a shot dose. Animals of all groups were sacrificed after 48 hours of radiation exposure.

Samples

Blood samples were collected by heart puncture. Serum of each blood samples was separated and kept frozen for biochemical assays. Livers tissue homogenate (10% w/v)in phosphate-buffered...
Arab Journal of Nuclear Science and Applications, 50 (2), (278-291) 2017

saline (0.02M Sodium phosphate buffer with 0.5 M Sodium chloride, pH 7.4) were prepared with portion of liver tissue in glass tissue homogenizer with a Teflon pestle.

In vitro Proliferation (MTT) Assay

MTT cell proliferation and viability assay was carried out in vitro for the measurement of cell proliferation or when metabolic events lead to apoptosis. It is based on the transformation and colorimetric quantification of MTT (3-(4,5-dimethylthiazol-2yl)-2, 5-diphenyltetrazolium bromide). All electron transport systems reduce MTT and other tetrazolium salts and thereby form non-water-soluble violet formazan crystals within the cell. The amount of these crystals can be determined spectrophotochernically and serves as an estimation for the mitochondrial activity and hence the number of living cells in the sample (Freimoser et al., 1999) according to the equation:

% viable cell = sample abs /control abs x 100.

Microorganism’s Preparation

It was prepared according to Janisiewicz (23).

Determination of SERUM TNF-α

Serum TNF-α was determined using a commercial mouse ELISA kit (Komabiotech) according to the manufacturer’s instructions. TNF-α was expressed in Pg/ml.

Measurement of Cox-2

Serum Cox-2 was measured using a commercial mouse ELISA kit according to the manufacturer’s instructions. Cox-2 was expressed in µm IC50.

Determination of Serum sPLA2

Serum sPLA2 was determined using a commercial mouse ELISA kit (Cayman chemical, USA) according to the manufacturer’s instructions. sPLA2 was expressed in U/ml.

Determination of SERUM IL-6 and IL-1β

Serum IL-6 and IL-1β were determined using a commercial mouse ELISA kit (Raybiotech, USA) according to the manufacturer’s instructions. IL-6 and IL-1β were expressed in Pg/ml.

Determination of Liver GSH Content

The GSH content was determined photometrically at 412 nm using 5, 5-dithiobis-2-nitrobenzoic acid (24).

Determination of GPx Activity in Liver

GPx activity was assayed according to the method of Gross et al (25).

Determination of Liver Lipid Peroxidation

The extent of lipid peroxidation was assayed by the measurement of MDA according to the procedure described by Yoshioka et al (26).

Statistical Analysis

All experiments were repeated at least six times. Results were expressed as the mean values ± standard error. SPSS test was used to perform statistical analysis.
RESULTS AND DISCUSSION

Numerous studies have focused on herbal remedies and botanicals because they offer much promise in health benefits and disease treatments without excessive side effects and cytotoxicity. In the present study, the chemical composition analysis of rhizome ginger and coriander seed has been conducted. The results represented in Table (1) revealed the major components of the ginger and coriander. Ginger examination showed 63.55% total Carbohydrate, 8.12% crude protein, 5.83% crude fiber, about 6.13% ash and volatile oil 1.68%. This results were in a partial agreement with Ghosh (27) who stated that powdered rhizome contains 60-70% carbohydrates, 9% protein, 3-8% crude fiber, about 8% ash, 9-12% water and 2-3% volatile oil. Coriander analysis was also carried out showed 58.87% total carbohydrate, 11.76% crude protein, 9.8% crude fiber, 5.98 ash and about 0.87% volatile oils. Also, similar results have been reported by Maury and Shruti (28) who showed that crude protein is 11% and essential is oil 0.84%.

Table (1): Chemical Compositions of Ginger rhizome and Coriander seeds

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Ginger</th>
<th>Coriander</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture Contents %</td>
<td>8.56</td>
<td>7.98</td>
</tr>
<tr>
<td>Crude Fibers%</td>
<td>5.83</td>
<td>9.8</td>
</tr>
<tr>
<td>Total Carbohydrate %</td>
<td>63.55</td>
<td>53.87</td>
</tr>
<tr>
<td>volatile Oil %</td>
<td>1.68</td>
<td>0.87</td>
</tr>
<tr>
<td>Crude Protein%</td>
<td>8.12</td>
<td>6.76</td>
</tr>
<tr>
<td>Ash%</td>
<td>6.13</td>
<td>5.98</td>
</tr>
<tr>
<td>Total Phenol%</td>
<td>2.51</td>
<td>0.56</td>
</tr>
<tr>
<td>total Flavonoids%</td>
<td>1.67</td>
<td>0.47</td>
</tr>
</tbody>
</table>

Antioxidant Activity of Ginger and coriander extracts

Data in Table (2) demonstrated the percentage of antioxidant activity in vitro DPPH assay comparable of the crude extracts of ginger and Coriander. Data revealed that methanol extract of ginger and coriander has the highest scavenging properties than those of other extracts 69.76 and 31.039 respectively. These results were in a good agreement with those reported by Hinneburg, et al (29) and Stoilova, et al. (30) who studied the antioxidant activity of the alcoholic extract of ginger and found that the DPPH inhibition reached up to 90.1%. Phenolic compounds represent a substantial portion of spice anti-oxidants (31). Addition of coriander to food will increase the antioxidant content and may have potential as a natural antioxidant and thus inhibit unwanted oxidation processes (32).

Table (2): % Antioxidant activity in Ginger and Coriander extracts (by DPPH)

<table>
<thead>
<tr>
<th>Extract</th>
<th>Ginger</th>
<th>Coriander</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexane</td>
<td>33.77</td>
<td>21.36</td>
</tr>
<tr>
<td>Methanol</td>
<td>69.76</td>
<td>31.039</td>
</tr>
<tr>
<td>Water</td>
<td>25.63</td>
<td>17.43</td>
</tr>
<tr>
<td>Essential oil</td>
<td>41.02</td>
<td>36.21</td>
</tr>
</tbody>
</table>

Essential Oils Extraction of Ginger and Coriander Using GC-MS and their Fractionation by HPLC

The volatile constituents of ginger and coriander were investigated by using GC-MS Table (3) and the their flavonoids were identified by HPLC Table (4). In the present work data revealed that the major components of ginger essential oils are α-Zingiberene followed by β-squiphellandrene and α-
Farnesene percentages of 48.50%, 20.18% and 18.75% respectively. Our results were in good agreement with Baliga et al. (33) who stated that ginger volatile oil consists mainly of the mono- and sesquiterpenes; camphene, β-phellandrene, zingiberol, β-sesquiphellandrene. Zingiberol is the principal aroma contributing component of ginger rhizome (34). Whereas, Linalool is the major essential oil component of coriander (40.43%) followed by geranyl acetate (9.54%) then γ-Terpinene (8.3%). Ebrahimia et al. (35) and Laribi et al. (36) confirmed that Linalool as an alifatic terpene was major component of all accessions of Coriander.

Table (3): Fractionation of Ginger and Coriander oils by GC-MS

<table>
<thead>
<tr>
<th>No</th>
<th>Compound name</th>
<th>Peak area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Ginger oil</td>
</tr>
<tr>
<td>1</td>
<td>α-pinene</td>
<td>1.46</td>
</tr>
<tr>
<td>2</td>
<td>β-pinene</td>
<td>---</td>
</tr>
<tr>
<td>3</td>
<td>Myrcene</td>
<td>---</td>
</tr>
<tr>
<td>4</td>
<td>α-terpinene</td>
<td>0.61</td>
</tr>
<tr>
<td>5</td>
<td>γ-Terpinene</td>
<td>0.64</td>
</tr>
<tr>
<td>6</td>
<td>p-cymene</td>
<td>---</td>
</tr>
<tr>
<td>7</td>
<td>Limonene</td>
<td>0.09</td>
</tr>
<tr>
<td>8</td>
<td>Camphor</td>
<td>---</td>
</tr>
<tr>
<td>9</td>
<td>1, 8 cineole</td>
<td>0.74</td>
</tr>
<tr>
<td>10</td>
<td>Linalool</td>
<td>---</td>
</tr>
<tr>
<td>11</td>
<td>Geraniol</td>
<td>0.71</td>
</tr>
<tr>
<td>12</td>
<td>Geranyl acetate</td>
<td>---</td>
</tr>
<tr>
<td>13</td>
<td>Terpineol</td>
<td>0.52</td>
</tr>
<tr>
<td>14</td>
<td>Caryophyllene</td>
<td>7.41</td>
</tr>
<tr>
<td>15</td>
<td>Citronellal</td>
<td>---</td>
</tr>
<tr>
<td>16</td>
<td>α-Zingiberene</td>
<td>48.50</td>
</tr>
<tr>
<td>17</td>
<td>α-Farnesene</td>
<td>18.75</td>
</tr>
<tr>
<td>18</td>
<td>β-sesquiphellandene</td>
<td>20.18</td>
</tr>
<tr>
<td>19</td>
<td>Bisabolene</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Table (4): Identification of flavonoids of Ginger rhizomes and Coriander seed by HPLC

<table>
<thead>
<tr>
<th>Compound name</th>
<th>Peak area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ginger</td>
</tr>
<tr>
<td>Myricetin</td>
<td>9.22</td>
</tr>
<tr>
<td>Luteolin</td>
<td>6.04</td>
</tr>
<tr>
<td>Quercetin</td>
<td>48.67</td>
</tr>
<tr>
<td>Catechin</td>
<td>3.23</td>
</tr>
<tr>
<td>Rutin</td>
<td>1.42</td>
</tr>
<tr>
<td>Apigenin</td>
<td>8.65</td>
</tr>
<tr>
<td>Naringen</td>
<td>2.44</td>
</tr>
<tr>
<td>Kaempferol</td>
<td>19.75</td>
</tr>
</tbody>
</table>
Antimicrobial Activity of Ginger and Coriander

Ginger and Coriander essential oils show in Table (5) and Fig (1) indicated that 100% inhibition against Alternaria alternate pathogen. Both ginger and coriander hexane extract reduced diameter of rot 95.46 and 92.59% respectively in comparison to control and more than methanol and water extracts.

The antimicrobial activity of ginger may be attributed to essential oil and oleoresin which exhibited significant antioxidant and anti-microbial activities (37). However, the exact mechanism of action is not well understood. Moreover, the antimicrobial activity of the essential oil of coriander could be owing to the presence of active compounds, such as linalool, α-pinene and β-pinene, p-cymene and γ-terpinenethis (38).

<table>
<thead>
<tr>
<th></th>
<th>Essential oil</th>
<th>Hexane</th>
<th>Methanol</th>
<th>Water</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginger</td>
<td>100</td>
<td>95.46</td>
<td>22.77</td>
<td>1.75</td>
<td>54.99</td>
</tr>
<tr>
<td>Coriander</td>
<td>100</td>
<td>92.59</td>
<td>21.68</td>
<td>0.00</td>
<td>53.57</td>
</tr>
<tr>
<td>Mean</td>
<td>100</td>
<td>94.03</td>
<td>22.23</td>
<td>0.87</td>
<td></td>
</tr>
</tbody>
</table>

L.S.D. at 5%

Plant = 0.865

Interaction = 1.223

Fig. (1): Tomato wounds with essential oil and hexane extracts and challenged with Alternaria Alternata

In vitro viability (MTT) assay

MTT assay is a well-recognized in vitro model used to test cytotoxicity of compounds against tumor cell lines as well as screening the compounds with potential anti-tumor properties (39). Different extraction methods of Ginger and Coriander extracts were investigated. EAC cells were considered control group with 100% viability. The in vitro cytotoxic activities of all doses of ginger and coriander are shown in Figs. (2) and (3) respectively. 100 % was chosen regarded to the least number viable cells recorded. The present results may be attributed to the presence of some compounds of ginger such as quercetin, apigenin, luteolin and myricetin which possess anticancer activities (40). Tang et al (41) reported that Coriandrum sativum has an anti-cancer activity; this may be attributed to the presence of linolenic acid. The coriander seed essential oil, particularly, its main component, linalool, has been shown to have anti-cancer effects (36).
Biochemical assays

Determination of GSH Content and GPx Activity In Rats Livers

Under normal conditions, most of the total glutathione pool in the cell is in the reduced form. There is a strong evidence that exposure to free radicals and oxidative stress rapidly decreases the concentration of reduced glutathione, while oxidized glutathione increases as a result of peroxides reduction or free radicals scavenging \(^{(42)}\). When exposed to oxidative stress, cells have established mechanisms to maintain the redox homoeostasis. The endogenous mechanism that includes enzymatic and non-enzymatic antioxidants, provides the first line of cellular defense against superoxide and hydrogen peroxides \(^{(43)}\). First, SOD transforms superoxide radicals into hydrogen peroxide, then the enzymes GPx and catalase turn the hydrogen peroxide to non-toxic products. The cytotoxic of ROS can be diminished when these three enzymes exist \(^{(33)}\).

The present work revealed a significant decline of antioxidants in groups exposed to (4Gy) \(\gamma\)-radiation \((Table (4) a and b)\). Nevertheless, the groups treated with ginger or coriander extracts showed a significant elevation of antioxidant levels. Increased concentrations of GSH in the cytosol are a suitable cofactor for the detoxifying enzymatic reactions catalyzed by GST and GPx. Administration of ginger and its compound zerumbone (a sesquiterpene) is reported to prevent radiation-induced depletion of the hepatic glutathione levels \(^{(33)}\). \(Prasad and Tyagi\)\(^{(44)}\) reported that ginger may upregulate or downregulate the gene expressions, depending on the target and cellular context. Ginger extract increases antioxidant enzymes including GSH, SOD, and glutathione peroxidase. The antioxidant effects of coriander essential oil may be due to its terpene and terpenoid components, e.g., camphor, limonene, \(\alpha\)-pinene and geraniol \(^{(36)}\). The chemical analysis revealed that linalool from terial and antioxidant activities \(^{(43)}\). Our results confirmed by \(Zielniok et al\) \(^{(43)}\) who proved that the presence of polyphenols (catechins quercetin, kaempferol and simple phenolic acids
(i.e. ellagic acid) increase the intracellular glutathione level by stimulating transcription of the glutamylcysteine synthetase – gene encoding a critical enzyme involved in glutathione synthesis. The elevation of MDA level was observed in irradiated group due to ROS produced by radiation (Table (4) c). Meanwhile, the groups treated with both ginger or coriander showed a significant amelioration of MDA. Prasad and Tyagi (44) stated that ginger extract attenuate the activities of xanthine oxidase and myeloperoxidase, as well as malondialdehyde (MDA) level. Kosinova et al. (46) stated that the presence of polyphenols in tested extracts of coriander especially (catechin) and simple phenolic acids were present in the highest concentrations, they can limit lipid peroxidation in vitro and in vivo. In previous work, lipid peroxidation has been shown to be effectively inhibited by coriander and white mustard polyphenols (43).

**Fig (4):** Effect of *Zingiber officinale* and/or *Coriandrum sativum* on antioxidants in liver of γirradiated mice. Each value represents the mean ± SE (n=6). Significance level at p< 0.05, where (a) significant vs control (C), (b) significant vs irradiated mice group (R)

**Effect of Ginger and Coriander extracts on PLA2, pro-inflammatory cytokines (IL-6, IL-1β and TNF-α) and Cox in serum of irradiated mice**

Inflammation involves convoluted coordination of numerous cellular and molecular events that occurred by both secreted (soluble) factors (including chemokines, cytokines, lipid mediators) and cell surface adhesion molecules (e.g., various selectins, integrins, intercellular adhesion molecules) expressed by both inflammatory (i.e., monocytes/macrophages, neutrophils) and non-inflammatory (e.g., endothelial) cells. Inflammatory response is a key element in the innate immune response system and is primarily mediated by cytokines (47).

The present study revealed that, the production of free radicals initiated by ionizing radiation exposure induces inflammation as a result of excess production of ROS. After ginger and coriander administration, a marked reduction in PLA2, pro-inflammatory cytokines (IL-6, IL-1β and TNF-α) and Cox2 have been observed. These results were illustrated in Figs. (5, 6, and 7) respectively.
Phospholipase A2 (PLA2) family enzymes act to hydrolyze membrane phospholipids at the sn-2 position to liberate unsaturated fatty acids from cellular membranes. They are crucial for IL-1β maturation and secretion. IL-1β is mainly secreted by monocytes/macrophages and dendritic cells, but also fibroblasts is involved in a variety of inflammatory processes. IL-1β further induces COX-2 expression in endothelial cells and is involved in edema formation, where it synergizes with PGE2\(^{2(48)}\). The reduction PLA2 as major biological targets of ginger phenylpropanoids is related to the specific inhibition of IL-1β secretion from monocytes/macrophages\(^{2(48)}\). Meanwhile, administration of coriander reduce circulating IL6 and IL1β, this may be contributed toward inhibition of macrophage activation, infiltration and aggregation\(^{49}\).

Ginger seems to inhibit the activation of tumor necrosis factor-alpha (TNF-a), interleukin-1β (IL-1β) 6-gingerol decreased TNF-a expression by inhibiting I-kappa B alpha phosphorylation, nuclear factor-kappa B (NF-kB) nuclear activation, and protein kinase C-alpha translocation. TNF-a-induced the production of COX2, and the TNF-a-induced activation of the NF-kB. In addition, these crucial compounds suppress the synthesis of prostaglandin and leukotriene by inhibiting the COX-2 and lipoxygenase pathways and also inflammation-involved pathways. This way, they can diminish the inflammation\(^{50}\). Heidari \textit{et al.}\(^{51}\), stated that linalool, the main components of coriander essential oil, has strong anti-inflammatory property as it inhibits pro-inflammatory mediator expression by suppressing necrosis factor (NF)-kappa B.

Fig(5): Effect of \textit{Zingiber officinale} and \textit{Coriandrum sativum}, and /or γ-radiation on PLA2(U/ml) serum level. Each value represents the mean ± SE (n=6). Significance level at p< 0.05, where (a) significant vs control (C), (b) significant vs irradiated mice group (R)

Fig(6): Effect of \textit{Zingiber officinale} and \textit{Coriandrum sativum} and /or γ-radiation on mice serum level of IL6(pg/ml) and IL1β(pg/ml). Each value represents the mean ± SE (n=6). Significance level at p< 0.05, where (a) significant vs control (C), (b) significant vs irradiated mice group (R)
Fig. (7): Effect of *Zingiber officinale* and *Coriandrum sativum*, and/or γ-radiation on TNF-α(pg/ml) and Cox2 (µm IC50) serum level mice. Each value represents the mean ± SE (n=6). Significance level at p< 0.05, where (a) significant vs control (C), (b) significant vs irradiated mice group (R)

**CONCLUSION**

In general, the results of this study indicated that ginger and coriander could serve, not only as flavor agent, but also as safe antioxidant and antiseptic supplement. They contain many chemical constituents which have anti-inflammatory effect against inflammation caused by gamma radiation. Ginger and coriander appear to be promising for safe use in medicine, pharmaceutical and food industries. The real population exposure to these compounds with regard to all beneficial and adverse effects (including potential interactions with other pharmaceuticals) remains unknown and should be the scope of a further investigation.

**REFERENCE**


(6) Mauer L., and El-Sohemy ,A(2012). Prevalence of cilantro (Coriandrum sativum) disliking among different ethnocultural groups Flavour, 1:8


