IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB)
ISSN: 2455-264X, Volume 5, Issue 1 (Jan. – Feb. 2019), PP 37-40
www.iosrjournals.org

The Effect of Ginger Extract (*Zingiber officinale* Roscoe) on antioxidant enzymes and free radical in rabbits

Ahlam A.K. Al-Ailla[1] and Fayrouz A. Khaled*[2]
[1]*Department of Botany, Faculty of Sciences, Omar AL-Mukhtar University, Libya*
[2*]*Department of Chemistry, Faculty of Sciences, Omar AL-Mukhtar University, Libya*
Corresponding Author: ayalzobair@yahoo.com

Abstract: *Ginger rhizome has a long history of use in traditional systems of medicine has been found to possess antioxidant effect that can control the generation of free radicals. Free radical level has been reported to be high in cancer cells. The aim of this study was to observe the effect of ginger extract on antioxidant status in rabbits. The effects of ginger on plasma glutathione (GSH), glutathione peroxidase (GPx), glutathione S-transferase (GST), catalase (CAT), superoxide dismutase (SOD) activities and thiobarbituric acid-reactive substances (TBARS) during the 12-week. Treatment with ginger caused significant (P<0.05) increase in the activity of GSH, GPx, GST, SOD and CAT in plasma compared to control, while (TBARS) was significantly (P<0.05) decreased compared with control group.*

Keywords: *antioxidant enzymes, free radical and Zingiber officinale Roscoe*

Date of Submission: 13-02-2019 Date of acceptance:28-02-2019

I. Introduction

Antioxidants are radical scavengers which protect the human body against free radicals that may cause pathological conditions such as ischemia, anemia, asthma, arthritis, inflammation, neurodegeneration, Parkinson's diseases, mongolism, ageing process and perhaps dementias [1]. Antioxidant helps to neutralize free radicals which are unstable molecules that are linked to a number of degradable diseases and conditions. They exhibit there antioxidant activity by inhibiting lipid peroxidation, scavenging for free radicals and active oxygen species, preventing the decomposition of hydrogen peroxide into free radicals and chelating metal ions [2]. Many plants species have been reported to possess antioxidant activity and are responsible for anti-inflammatory activity and analgesic activity [3]. The antioxidant property of ginger has been proposed as one of the major possible mechanisms for the protective effects of the plant against toxicity and lethality of radiation [4] and a number of toxic agents such as carbon tetrachloride, arsenic and cisplatin [5]. Furthermore, the antioxidant efficacy has also been implicated in its use as an anti-ulcer drug [6]. In spite of the numerous studies dedicated to this area, comprehensive investigations of the *in vitro* antioxidant properties of aqueous and ethanol extracts of ginger (Nigerian variety) are very limited in the literature. Since the constituents of ginger are numerous and vary depending on the place of origin and whether the rhizomes are fresh or dry [7].Ginger is a strong anti-oxidant substance and may either mitigate or prevent generation of free radicals. It is considered a safe herbal medicine with only few and insignificant adverse/ side effects [7]. Its major pungent constituent, [6]-gingerol has been reported to exhibit anti-oxidative activity against linoleic acid autoxidation and peroxidation of phospholipid liposomes and to scavenge trichloromethylperoxyl- and 1,1- diphenyl-2-picrylhydrazyl (DPPH) radicals [8]. The major bioactive constituents of ginger are [6]-gingerol, [8]-gingerol, [10]-gingerol and [6]-shogaol having various pharmacological properties including antioxidant, anti inflammatory, anticancer and anti-ulcer properties [9].The bioactive molecules of ginger like gingerols have shown antioxidant activity in various modules [10]. Some studies were started to analyses the structure-activity relationship of gingerols and shogaol for their antioxidant activities using DPPH free radical bleaching. The assay has been routinely used to test hydrogen atom donation activity for antioxidants [10]. [6]-shogaol was found to exhibit a significant DPPH scavenging activity than that of gingerols. It has been well-known that metal-binding properties of phenolic compounds offered antioxidant action by encapsulation of a pro-oxidant iron species, which generates hydroxyl radical species through the Fenton reaction [11]. The determined total phenolic content of the extract amounted to 871 mg/g dry extract. It is well known that the antioxidant activity of ginger extracts containing polyphenol components is due to their capacity to be donors of hydrogen atoms or electrons and to capture the free radicals. DPPH analysis is one of the tests used to prove the ability of the components of the ginger extract to act as donors of hydrogen atoms [7]. Another study found that administration of ginger powder caused significant decreases in TBARS levels. This decrease in TBARS levels may increase the activity of glutathione peroxidase (GPx) in treated rabbits and hence cause inactivation of lipid peroxidation reactions [12]. The purpose of this

study to find out The Effect of Ginger Extract (*Zingiber officinale* Roscoe) on antioxidant enzymes and free radical in rabbits.

II. Materials And Methods

Materials: In this study ginger was obtained from Superior Nutrition and Formulation by Jarrow Formulas, Los Angeles, USA. All other chemicals used in the experiment were of analytical grade. Mature male New Zealand White rabbits (age of 7 months and initial weight of (2.917 ± 28.9 Kg) were used. Ten mature male rabbits were randomly divided into couple equal groups (each five rabbits): Group I: Rabbits were used as control and received an equivalent volume of the vehicle (corn oil) alone by oral gavage daily for 12 successive weeks. Group II: Rabbits were treated with ginger. Ginger was given ginger daily by gavage at a dose of 100 mg/kg B.W [13], which dissolved in corn oil for 12 successive weeks

Methods: At the end of the experimental period, all rabbits were weighed then sacrificed under ether anesthesia. Blood samples were collected in clean dry centrifuge tubes. Plasma was separated by centrifugation at 3000 rpm for 10 minutes and then quickly frozen at -20°c for antioxidant enzymes and free radical analysis.

Blood enzyme activities: The activities of plasma Glutathione S-transferase (GST; EC 2.5.1.18) activity was determined according to [14]. Catalase (CAT; EC 1.11.1.6) activity was determined using the Luck method involving the decomposition of hydrogen peroxide [15]. Superoxide dismutase (SOD; EC 1.15.1.1) activity was measured according to [16]. Plasma thiobarbituric acid-reactive substances (TBARS) were measured by the method of [17].

III. Result

Thiobarbituric acid reactive substances (TBARS) are produced by lipid per oxidation (LPO) and are considered as indicators of oxidative stress. LPO was assessed by measuring the concentrations of thiobarbituric acid-reactive substances TBARS in plasma of male rabbits treated with ginger. As shown in Table1, the data recorded plasma levels of glutathione (GSH), glutathione peroxidase (GPx), glutathione S- transferase (GST) catalase (CAT), superoxide dismutase (SOD) activities and thiobarbituric acid-reactive substances (TBARS) during the 12-week. Treatment with ginger caused significant ($P<0.05$) increase in the activity of GSH, GPx, GST, SOD, CAT in plasma compared to control. While, ginger caused significant ($P<0.05$) decrease in the (TBARS).

Table 1: The overall means (±SEM) of different parameters during treatment of male rabbits with ginger

Parameters	Animal Groups	
	Control	ginger
Glutathione (GSH; U/ml)	5.7 ± 0.10^{b}	6.2 ± 0.13^{a}
Glutathione peroxidase (GPx; U/ml)	10.33 ± 0.184^{b}	11.08 ± 0.230^{a}
Glutathione S-transferase (GST; µmol/hr)	1.020 ± 0.018^{b}	1.131 ± 0.036^{a}
Catalase (CAT; U/min/ml)	1.294 ± 0.017^{b}	1.448 ± 0.031^{a}
Superoxide dismutase (SOD; U/ml)	1.154 ± 0.022^{b}	1.280 ± 0.022^{a}
Thiobarbituric acid-reactive substances (TBARS)	1.728 ± 0.025^{b}	1.477 ± 0.048^{c}

Values are means ± SE of 5 rabbits in each group. Mean with different letters (a- d) are significantly difference ($p \leq 0.05$). Mean with the same letters (a-d) are non- significantly difference ($p \geq 0.05$).

IV. Discussion

Free radicals and reactive oxygen species are continuously produced in the human body. These oxygen species are the cause of cell damage and the progression of tumor cells to cancer cells. Glutathione S-transferase plays a key role in cellular detoxification by catalyzing the reaction of glutathione with toxicants to form an S-substituted glutathione [18]. Superoxide dismutase has an antitoxic effect against the superoxide anion; SOD accelerates the dismutation of superoxide to H_2O_2 which is removed by catalase [19]. Thus SOD can be acting as a primary defense and prevents further generation of free radicals. While, catalase catalyzes the removal of H_2O_2 that formed during the reaction by SOD [20]. The activities of glutathione (GSH), glutathione peroxidase (GPx), glutathione S transferase (GST), catalase (CAT) and superoxide dismutase (SOD) were measured in plasma of male rabbits treated with ginger. Data in Tables 1 indicated that treatment with ginger significantly ($p<0.05$) increased (GSH), (GPx), (GST), (CAT) and (SOD) activities in plasma compared to control group. Increase in GST, SOD and CAT activities in plasma of rabbits treated with ginger (100 mg/kg) are in agreement with the finding of [21], who reported that ginger increased the antioxidant SOD and CAT enzyme activities. Also, [22] showed that ginger has an antioxidant property. Another study reported that the antioxidant effect of ginger by decreasing lipid peroxidation, increasing GSH level and maintaining normal levels of antioxidant enzymes [13], who found that hepatic levels of total and reduced GSH are restored to control values with pre-treatment of the rats with ethanolic extract of ginger at a

dose of 100 mg/kg, the same dose used in the present study. Also, they reported that the activities of antioxidant enzymes GPx and SOD were increased in liver tissues of the same animals [13]. Thiobarbituric acid reactive substances (TBARS) are produced by lipid peroxidation (LPO) and are considered as indicators of oxidative stress. LPO was assessed by measuring the concentrations of thiobarbituric acid-reactive substances (TBARS) in plasma and organs [23]. The free radicals attack cell structures can initiate lipid peroxidation and DNA damage leading to mutagenesis, carcinogenesis, liver damage, diabetes, respiratory disease, cataracts and central nervous system disorders and cell death, if the antioxidant system is impaired [24]. The oxygen-free radicals or oxy radicals and reactive oxygen species (ROS) are: superoxide, hydroxyl radical, lipid peroxy radical, singlet oxygen, hydrogen peroxide, hypochlorous acid. Thus, while oxygen is needed for life, it can also be dangerous to our health [25]. Lipid peroxidation is one of the main manifestations of oxidative damage and has been found to play an important role in the toxicity of many xenobiotics [26]. Also, oxidative damage to biomolecules, such as lipids, DNA, and proteins, has been implicated in many chronic diseases, in particular, cardiovascular disease, cancer, and cataract [27]. Decrease in free radicals of rabbits treated with ginger (Tables 1) is in accordance with another published study [28], in which ginger was demonstrated to be a strong antioxidant. Its antioxidant activity has been attributed to its major active phenolic ingredients (e.g., zingerone, gingerdiol, zingibrene, gingerols and shogaols). In addition, the administration of ginger has been shown to improve oxidative stress by decreasing lipid peroxidation and protein oxidation as free radical-generating sources and elevating the levels of enzymes implicated in the antioxidant defence system. Antioxidant capacity in the ginger treated rats was higher when compared to the other two groups. Also, [29] found that ginger significantly decreased TBARS concentrations in rats as compared with those before the intake. This result shows that these vegetables suppress lipid peroxidation and the formation of malonaldehyde in rats. 8-OHdG is most commonly formed by the actions of reactive oxygen species on guanine. Previous study reported that the administration of ginger decreased the TBARS levels in diabetic rats [30]. This decrease in TBARS levels may be associated with the increase in the activities of antioxidant enzymes in treated rats which causes inactivation of the lipid peroxidation reaction.

V. Conclusions

Obtained results of this study demonstrated, that ginger has beneficial effects on free radical and serum anti-oxidants level which could be effective for maintaining healthy.

References

[1]. Oke, J. M. and Hamburger, M. O. (2002). Screening of some Nigerian Medicinal Plants for antioxidant activity using 2,2, diphenyl-picryl-hydrazyl radical. Afr. J. Bio. Res., 5: 77-79.

[2]. Chinedu, P. A., Ijeoma, E., Olushola, A. and Ayobami, O. A. (2011). Polyphenolic a content and antioxidant activity of Hibiscus sapdariffa calyx. Res. J. Med. Plant., 5: 557-566.

[3]. Sofidiya, M. O., Odukoya, O. A., Familoni, O. B. and Inya-Agha, S. I. (2006). Free Radical Scavenging Activity of Some Nigerian Medicinal Plant Extracts. Pakistan. J. Biol. Sci., 9: 1438-1441.

[4]. Haksar, A., Sharma, A., Chawla, R., Kumar, R., Arora, R. and Singh, S. (2006). Zingiber officinale exhibits behavioral radioprotection against radiation. Pharm. Biochem. Behaviour., 84: 179-188.

[5]. Morakinyo, A. O., Achema, P. U. and Adegoke, O. A. (2010). Effect of Zingiber officinale (Ginger) on sodium arsenite-induced reproductive toxicity in male rats. African. J. Bio. Med. Research., 13: 39-45.

[6]. Siddaraju, M. N. and Dharmesh, S. M. (2007). Inhibition of gastric H+,K+,ATPase and Helicobacter pylorigrowth by phenolic antioxidants of Zingiber officinale. Mol. Nut. Food Research., 51: 324-332.

[7]. Badreldin, H. A., Blunden, G., Tanira, M. O. and Nemmar, A. (2008). Some phytochemical, pharmacological and toxicological properties of ginger (Zingiber of ficinale Roscoe). A review of recent research. Food Chem. Toxicol., 46: 409-420.

[8]. Jihène L, Amira T, Saber C, Fethi, Z (2013). Impact of infra-red drying temperature on total phenolic and flavonoid contents, on antioxidant and antibacterial activities of ginger (Zingiber officinale Roscoe). J Environ Sci Toxicol Food Technol., 6(5): 38–46.

[9]. Shukla, Y. and Singh, M. (2007). Cancer Preventive Properties of Ginger: A Brief Review. Food Chem. Toxicol., 45 (5): 683-690.

[10]. Dugasani, S., Pichika, M. R., Nadarajah, V. D., Balijepalli, M. K., Tandra, S. and Korlakunta, J. N. (2010). Comparative antioxidant and anti-inflammatory effects of [6]-gingerol, [8]-gingerol, [10]-gingerol and [6]-shogaol. J. Ethno. pharm., 127: 515-520.

[11]. Ferrali, M., Signorini, C., Caciotti, B., Sugherini, L., Ciccoli, L., Giachetti, D. and Comporti, M. (1997). Protection against oxidative damage of erythrocyte membrane by the flavonoid quercetin and its relation to iron chelating activity. FEBS Lett., 416: 123-129.

[12]. Aydin, M. and Yilmaz, B. (2007). Comparative evaluation of hepatotoxic and nephrotoxic effect of aroclors 1221 and 1254 in female rats. Cell Biochemistry Function, 25(2): 167-72.

[13]. El-Sharaky, A. S.; Newairy, A. A.; Kamel, M. A. and Eweda, S. M. (2009). Protective effect of ginger extract against bromobenzene-induced hepatotoxicity in male rats. Food and Chem. Toxicol., 47: 1584-1590.

[14]. Habig, W.H., Pabst, M.J. and Jakoby, W.B., (1974). Glutathione S-transferases. The first enzymatic step in mercapturic acid formation. J. Biol. Chem., 249: 7130-7139.

[15]. Luck, H., 1974. Catalase. In: Bergmayer, M.V. (Ed.), Method of Enzymatic Analysis. Verlag Chemic. Academic Press, New York. P: 885.

[16]. Mishra, H.P. Fridovich, I., (1972). The role of superoxide anion in the autoxidation of epinephrine and a simple assay for superoxide dismutase. J. Biolog. Chem., 247: 3170-3175.

[17]. Tappel, A.L., Zalkin, H., (1959). Inhibition of lipid peroxidation in mitochondria by vitamin E. Arch. Biochem. Biophys. 80: 333-336.

[18]. Danyelle, T. M. and Kenneth, T. D. (2003). The role of glutathione-S-transferase in anti-cancer drug resistance. Oncogene 22 (47): 7369-7375.

[19]. Usoh, I. F.; Akpan, E. J.; Etim, E. O. and Farombi, E. O. (2005): Antioxidant Actions of Dried Flower Extracts of Hibiscus sabdariffa L. On Sodium Arsenite - Induced Oxidative Stress in Rats. Pakistan J. Nutr., 4 (3): 135-141.
[20]. Ramanathan, K.; Balakumar, B. S. and Panneerselvam, C. (2002). Effects of ascorbic acid and a-tocopherol on arsenic-induced oxidative stress. Human Exp. Toxicol., 21 (12): 675-680.
[21]. Masuda, Y., Kikuzaki, H., Hisamoto, M. and Nakatani, N., (2004). Antioxidant properties of gingerol related compounds from ginger. Biofactors. 21: 293-296.
[22]. Shanmugam, K.R., Ramakrishna, C.H., Mallikarjuna, K. and Sathyavelu, R.K., 2010. Protective effect of ginger in alcohol-induced renal damage and antioxidant enzymes in male albino rats. Indian Journal of Experimental Biology. 4: 143-149.
[23]. Block, G. (1991). Vitamin C and cancer prevention: the Epidemiological Evidence. Am. J. Clin. Nutr., 53: 3145-3215.
[24]. Devi, G. S.; Prasad, M. H.; Saraswathi, I.; Raghu, D.; Rao, D. N. and Reddy, P.P. (2000). Free radicals antioxidant enzymes and lipid peroxidation in different types of leukemias. Clin. Chemi. Acta., 293: 53-62.
[25]. Block, G. (1992). A role for antioxidants in reducing cancer risk. Nutr. Rev., 50: 207-213.
[26]. Anane, R. and Creppy, E. E. (2001). Lipid peroxidation as pathway of aluminium cytotoxicity in human skin fibroblast cultures: prevention by superoxide dismutase catalase and vitamins E and C. Hum. Exp. Toxicol., 20: 477-481.
[27]. Carr, A. C. and Frei, B. (1999). Toward a new recommended dietary allowance for vitamin C based on antioxidant and health effects in humans. American. J. Clin. Nutr., 69(6): 1086-1107.
[28]. Saeid, J. M.; Shanoon, A. K. and Marbut, M. M. (2011). Effects of Zingiber officinale Aqueous Extract on Semen Characteristic and Some Blood Plasma, Semen Plasma Parameters in the Broilers Breeder Male International. J. Poult. Sci., 10 (8), 629-633.
[29]. Ippoushi, K.; Takeuchi, A.; Hidekazu, I.; Hideki, H. and Keiko, A. (2007). Antioxidative effects of daikon sprout (Raphanus sativus L.) and ginger (Zingiber officinale Roscoe) in rats. Food Chem., 102: 237-242.
[30]. Afshari, A. T.; Shirpoor, A.; Farshid, A.; Saadatian, R.; Rasmi, Y. and Saboory, E. (2007). The effect of ginger on diabetic nephropathy, plasma antioxidant capacity and lipid peroxidation in rats. Food Chem., 101: 148-153.

IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB) is UGC approved Journal with Sl. No. 4033, Journal no. 44202.

Ahlam A.K ." The Effect of Ginger Extract (Zingiber officinale Roscoe) on antioxidant enzymes and free radical in rabbits." IOSR Journal of Biotechnology and Biochemistry (IOSR-JBB) 5.1 (2019): 37-40.