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Role of *Zingiber Officinale* Rhizome Powder on Sex Hormones and Antioxidant Enzymes in The Male Rabbits

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Abstract

The objective of this study was to investigate the effect of Zingiber Officinale rhizome powder administration (100 or 200 mg/kg) orally by gastric tube for 21days to male rabbits. Administration of Zingiber Officinale orally at dose 100 mg/kg caused a significant increase ($p<0.05$) on testosterone, FSH and LH concentration in the serum compared with control group. However, administration of Zingiber Officinale rhizome powder suspension orally at dose 200 mg/kg for 21 days, caused a non-significant increase in serum testosterone , FSH and a significant increase in serum LH compared with control group, The elevation of Testosterone, FSH and LH in G2 were 33.43% , 51.47% and 54.4%, and in G3 were 13.26%, 13.73 and 28.6% respectively when compared to control group. Administration of Zingiber Officinale rhizome powder suspension orally at dose 100 mg/kg or 200 mg/kg for twenty one days, caused a significant elevation in the levels of GST (67.36% and 74.99 %) and CAT (174.36% and 183.39%), respectively when compared to control group. A significant ($P<0.05$) increase in GST (67.36% and 74.99 %) and CAT (174.36% and 183.39%), respectively was observed in Zingiber Officinale treated animals at dose 100 mg/kg or 200 mg/kg for 21 days compared with control group. In conclusion, the present study has demonstrated that, Zingiber Officinale rhizome powder suspension possess an androgenic and antioxidant activity in doses of 100 and 200 mg/kg respectively in adult male rabbits.

Keywords: *Zingiber Officinale, ginger, testosterone, FSH, LH, antioxidant enzymes, rabbits.*

1. Introduction

Zingiber officinale commonly called ginger belongs to the family of Zingiberaceae, it has been used in medicine for centuries. ginger root is widely used as a digestive aid for mild stomach upset and is commonly recommended by health care professionals to help prevent or treat nausea and vomiting associated with motion sickness, pregnancy, and cancer chemotherapy [1, 2, 3]. Nowadays ginger rhizome is used worldwide as a spice.

Both antioxidative and androgenic activities of *Z. officinale* were reported in animal models [4,5]. All major active ingredients of *Z. officinale*, such as zingerone, gingerdiol, zingibrene, gingerols and shogaols, have antioxidant activity [6], and androgenic activities [5] which were reported in animal models. The important active components of the ginger root are thought to be volatile oils and pungent phenol compounds such as gingerols, shogaols, zingerone, and gingerols [4,6]. Although the beneficial effect of ginger has been exploited, little research has been conducted on its activity on male reproductive functions except a study that reported that *Z. officinale* possess androgenic property [5]. LH and FSH hormones are the main regulatory hormones used for stimulation of steroid hormone production including testosterone and gametogenesis in both men and women [7]. ginger and its extracts possess some pharmacological activities including hypoglycemic, insulinotropic and hypolipidemic in human [8] and in experimental animals [9,10]. The anti-inflammatory and antioxidant properties in ginger help to relieve various inflammatory disorders like gout, osteoarthritis and rheumatoid arthritis [11]. The antioxidants in ginger include gingerols, shogaols, monoterpenes, sequiterpenes, some phenolic derivatives and other phytochemicals which are responsible for their pharmacological activities [12].

This work was aimed to evaluate of the dry ginger rhizomes powder suspension on reproductive functions and antioxidant activities in male rabbits**.**

2. Materials and methods

Experimental Animals:

Fifteen local domestic Adult male rabbits weighing 1.50-2.33 kg, were used in the study. The rabbits were kept in a controlled environment at the laboratories of the zoology department, Sirte University. The photoperiod was regulated at 12 hours light / 12 hours dark cycle and temperature was adjusted at 25±1˚C. and were allowed free access to standard chow diet and water during study.

Plant material and preparation:

The dry Rhizome of Ginger (*Zingiber officinale*), were obtained from local herbal market and was identified and authenticated by department of botany, faculty of science, university of Sirte, Sirte, Libya. The Rhizome were cleaned and grounded into fine powder. Known weight of their powders was used as suspension in constant distilled water volume for the experiment.

Experimental Design:

Rabbits were divided into **control group (G1)**, given distilled water orally (2.0 mL) for 21 days. ***Z. officinale* 100 mg groups(G2)**, administered *Zingiber officinale* rhizome powder suspension with oral injection by (Gastric tube) at a dose of 100 mg/kg body weight **[13]** for each rabbit (21 days), and the last group ***Z. officinale* 200 mg (G3)**, received *Zingiber officinale* rhizome powder suspension with orally at a dose of 200 mg/kg body weight **[14]** for each rabbit (21 days).

Blood sampling:

At the end of the experimental period (21 days), overnight fasting rabbits were deprived of food but allowed for free access of drinking water. Animals were sacrificed by decapitation and the shed blood was collected in two cleaned vials, one was without anticoagulant and used for serum separation. The serum was analyzed to determine the testosterone, FSH and LH. The second vial (with EDTA) for plasma separation. The plasma was analyzed to determine the Glutathione-S-Transferase (GST) and Catalase (CAT) activities. Both plasma and sera were obtained by centrifugation at 3000 rpm for 10 min.

Serum total testosterone, FSH and LH hormones measurements:

The testosterone was estimated using Elecsys Testosterone Enzyme Immune Assay Test Kit, Cat. No.: BC – 1115 , By : Digital and Analog Systems (dos). Serum LH was determined **[15]** using reagent kits purchased from Monobind, INC (USA). FSH level in serum was determined **[16]** using reagent kits purchased from Monobind, INC (USA). The appropriate kit (Stanbio reagent kit, Stanbio Laboratory Inc., Boerne, TX, USA).

Catalase concentration measurement in plasma:

Catalase reacts with a known quantity of H_2O_2. The reaction is stopped after exactly one minute with catalase inhibitor. In the presence of peroxidase(HRP), remaining H_2O_2 reacts with 3,5-Dichloro-2 hydroxybenzene sulfonic acid (DHBS) and 4-aminophenazone (AAP) to form a chromophore with a color intensity inversely proportional to the amount of catalase in the original sample [17].

Glutathione-S-Transferase concentration measurement in plasma:

Glutathione-S-Transferase assay Kit (biodiagnostic) measures total GST activity (cytosolic and microsomal) by measuring the conjugation of 1-chloro- 2,4-dinitrobenzene (CDNB) with reduced glutathione. The conjugation is accompanied by an increase in absorbance at 340 nm. The rate of increase is directly proportional to the GST activity in the sample. [18].

Statistical Analysis:

The results were expressed as mean ± standard error (SE) for five animals in each group. The data were analyzed using IBM computer and SPSS statistical package. The One-way analysis of variance (ANOVA) and Student's t test were used to detect differences between the control group and the other experimental groups of animal. The significant differences were considered at $P<0.05$ [19].

3. Results and Discussion

Table 1 showed administration of ginger powder rhizome suspension orally at dose 100 mg/kg for twenty one days had significant increase ($p<0.05$) on Testosterone, FSH and LH concentration in the serum compared with control group. However, administration of Zingiber Officinale rhizome powder suspension orally at dose 200 mg/kg for 21 days, caused a non-significant increase in serum testosterone , FSH and a significant increase in serum LH compared with control group. The elevation of Testosterone, FSH and LH in G2 were 33.43% , 51.47% and 54.4%, and in G3 were 13.26%, 13.73 and 28.6% respectively when compared to control group. These findings showed that *Zingiber*

Officinale rhizome powder suspension have a potent androgenic activity, These results agree with the findings recorded by [20, 21], and agree with [22] suggested that *Zingiber Officinale* have a beneficial effect on male reproductive functions in rats, which confirmed the increased sperm counts, motility, testosterone, and decrease malonhydialdehyde levels. Another study in which rats were administered ginger rhizome powder in daily dosages of 50 and 100 mg/kg for 20 days did not demonstrate any changes in morphology or weight of testes compared to control rats; however serum testosterone levels increased in the experimental group that received 100 mg ginger/kg/day [23]. Besides, the percentage of sperm viability and motility in both test groups significantly increased in comparison to the control group, whereas, LH, FSH, and sperm concentration in both experimental and control group were similar.[24] reported that onion and ginger cause an increase in sexuality in proportion to the control group. On other hand, it was recognized that this group's lamotrigine causes reduction in sexuality and the simultaneous use of lamotrigine, onion and ginger causes positive effects of onion and ginger on sexuality. An inclusive study showed that the effect of ginger on male procreation is as follows: in the mentioned study after treatment with ginger, the weight of testis and epididymis increased significantly, also the number of sperms was counted and their movements increased also. After treatment, testosterone increased and malonhydriodehyde was reduced [22]. .Moreover, ginger and cinnamon both have been indicated to improve testicular function, sperm quality and quantity, sex hormones levels(Testosterone, LH and FSH), and serum antioxidants level [25-31] demonstrated that 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. In our study, administration of *Zingiber Officinale* rhizome powder suspension orally at dose 100 mg/kg or 200 mg/kg for twenty one days, caused a significant elevation in the levels of GST (67.36% and 74.99 %) and CAT (174.36% and 183.39%), respectively when compared to control group (table 2). Ginger and cinnamon contribution to the recovery of sperms, and their uptake on free radicals, are related to their very high antioxidant virtue and increasing antioxidant capacity of

male diabetic sperms manifested by recovered sperm parameters and decreased MDA level. [32] demonstrated that *Z.officinal* increased the activities of testicular antioxidant enzymes, superoxide dismutase, glutathione and catalse and reduced level of malondialdhyde. Although the active compounds of the tested plants have not been well identified in the present study, preliminary phytochemical study revealed the presence of alkaloids and/or nitrogenous bases, carbohydrates and/or glycosides, tannins, flavonoids, saponins and unsaturated sterols and/or triterpenes as major active constituents. Saponins, flavonoids, and alkaloids have been previously reported in the crude extract of ginger [33]

In conclusion, the present study has demonstrated that, *Zingiber Officinale* rhizome powder suspension possess an androgenic and antioxidant activity in doses of 100 and 200 mg/kg respectively in adult male rabbits.

Table 1. Values of Testosterone, FSH and LH hormones (Means ± SE) for control and treated groups of rabbits.

groups / **Parameters**	**(G1) Control**	**(G2) (zinger 100 mg)**	**(G3) (zinger 200 mg)**
testosterone(ng/ml)	3.62±0.26	4.83 ± 0.12 [a]	4.10± 0.10 [b]
% of Change from G1		33.43	13.26
% of Change from G2			- 15.11
FSH (µIu/l)	2.04±0.02	3.09± 0.26 [a]	2.32 ± 0.08 [b]
% of Change from G1		51.47	13.73
% of Change from G2			- 24.92
LH (µIu/l)	5.00±0.02	7.72± 0.23 [a]	6.43 ± 0.51 [a b]
% of Change from G1		54.4	28.6
% of Change from G2			- 16.71

Values are given as mean ± SE for 5 rabbits in each group.
[a] significant (P< 0.05) as compared with (G1).
[b] significant (P< 0.05) as compared with the (G2).

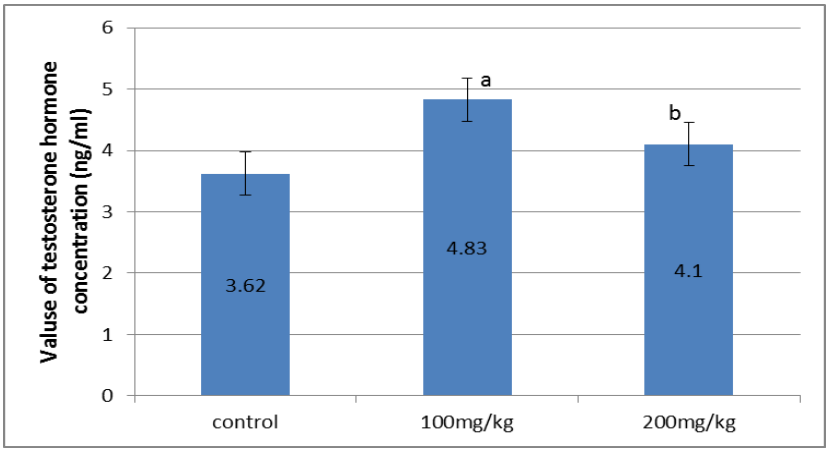

Figure 1 . Values of testosterone hormone levels (Means ± SE) for control and treated groups of rabbits.

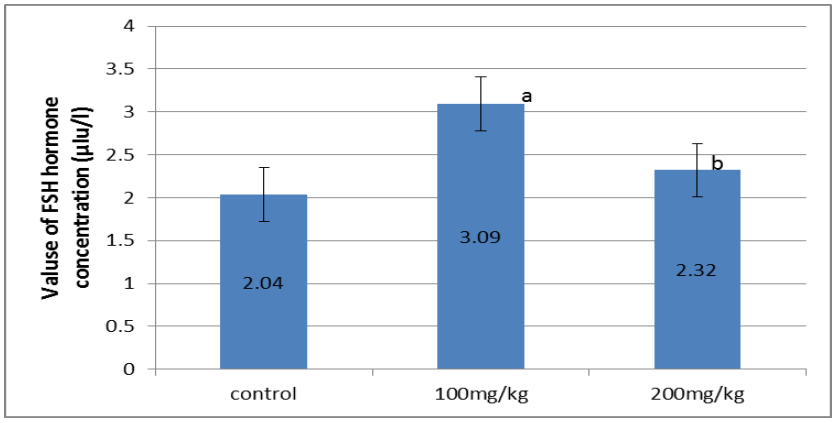

Figure 2. Values of FSH hormone levels (Means ± SE) for control and treated groups of rabbits.

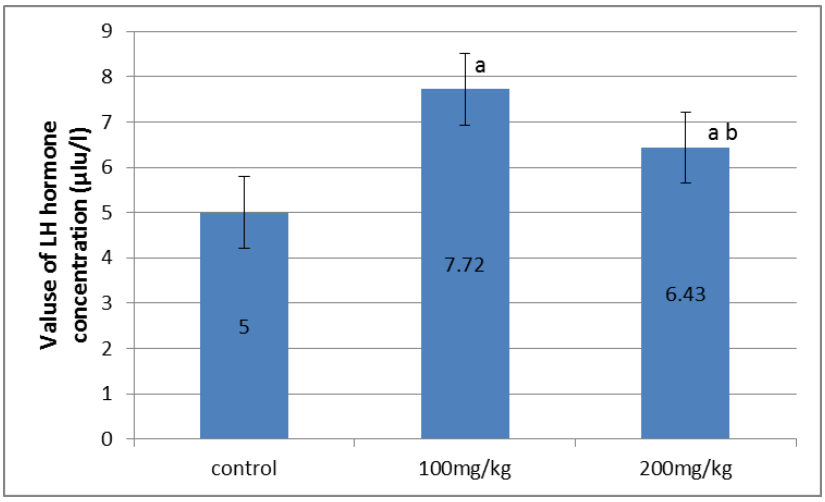

Figure 3. Values of LH hormone levels (Means ± SE) for control and treated groups of rabbits.

Table 2. Values of antioxidant enzymes (Glutathion-S-transferase and Catalase) (Means ± SE) for control and treated groups of rabbits.

Groups / Parameters	(G1) Control	(G2) (zinger 100 mg)	(G3) (zinger 200 mg)
GST (U/L)	406.20±17.57	679.80±19.02[a]	701.80±8.85[a]
% of Change from G1		**67.36**	**74.99**
% of Change from G1			**3.24**
Catalase(U/L)	135.08±2.50	370.60±20.71[a]	382.80±13.40[a]
% of Change from G1		**174.36**	**183.39**
% of Change from G1			**3.29**

Values are given as mean ± SE for 5 rabbits in each group.
[a] significant (P< 0.05) as compared with control group (G1).

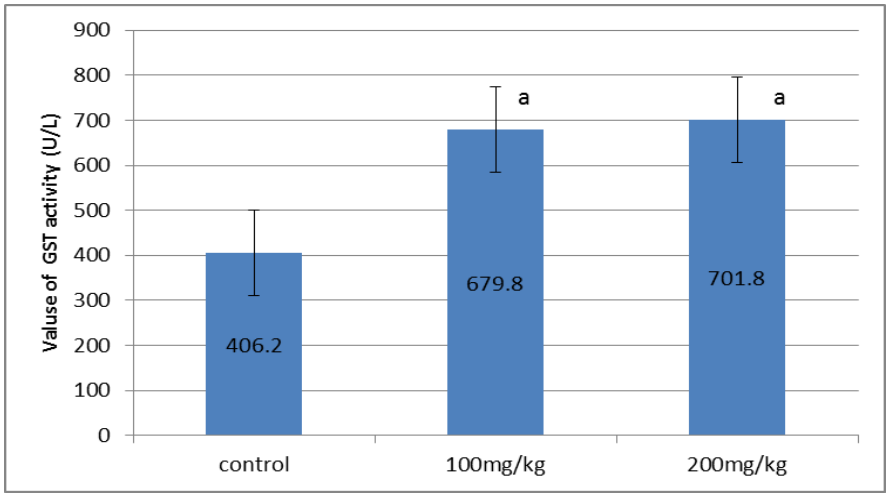

Figure 4. Values of GST activity (Means ± SE) for control and treated groups of rabbits.

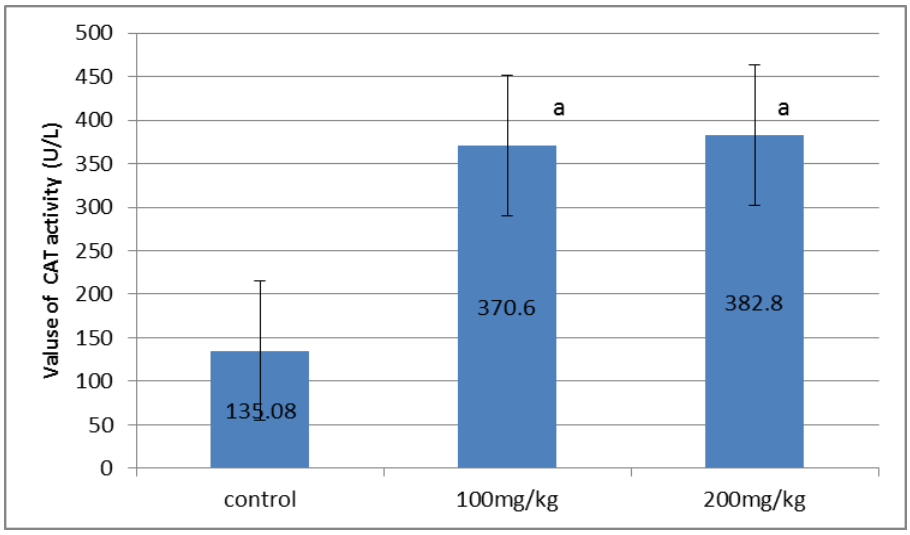

Figure 5. Values of CAT activity (Means ± SE) for control and treated groups of rabbits.

4. References

[1] Bone ME, Wilkinson DJ, Young JR, McNeil J and Charlton S. Ginger root, a new antiemetic. The effect of ginger root on postoperative nausea and vomiting after major gynaecological surgery.*Anaesthesia.* 1990*;* 45(8): 669-71.

[2] Grontved A, Brask T, Kambskard J and Hentzer E. Ginger root against seasickness: a controlled trial on the open sea. Acta Otolaryngol. 1988;105: 45-49.

[3] Sripramote M and Lekhyananda N. A randomized comparison of ginger and vitamin B6 in the treatment of nausea and vomiting of pregnancy. J Med Assoc Thai, 2003; 86(9): 846-853.

[4] Sekiwa Y, Kubota K and Kobayashi A. Isolation of novel glucosides related to gingerdiol from ginger and their antioxidative activities. J Agr Food Che 2000;48:373-7.

[5] Kamtchouing P, Fandio GYM, Dimo T and Jatsa HB. Evaluation of androgenic activity of *Zingiber officinale* and *pentadiplandra brazzeana* in male rats. *Asian J Androl*. 2002; 4:299-301.

[6] Zancan KC, Marques MO, Petenate AJ and Meireles MA. Extraction of ginger (Zingiber officinale Roscoe) oleoresin with CO2 and co-solvents: a study of the antioxidant action of the extracts. Journal of Supercritical Fluids, 2002;. 24(1), 57– 67.

[7] Arikawe AP, Oyerinde A, Olatunji-Bello I I and Obika LO. Streptozotocin diabetes and insulin resistance impairment of spermatogenesis in adult rat testis: central Vs local mechanism. Niger J Physiol Sci., 2012; 18; 27 (2):171-9.

[8] Huang CN, Horng JS and Yin MC. Antioxidative and antiglycative effects of six organosulfur compounds in low density lipoprotein and plasma. J. Agric. Food Chem., 2004; 52 (11): 3674-3678.

[9] Omar T Y and Hmmam F H. Effect of ginger*(Zingiber officinale)* powder on some biochemical parametersS in rabbits. J. 2016.

[10] Kondeti RS, Korivi M, Kesireddy N, Kuo CH and Kiesireddy SR. Protective effect of dietary ginger on antioxidant enzymes and oxidative damage in experimental diabetic rat tissues. Food Chem., 2011; 124 (4): 1436-1442

[11] Habib SHM, Makpol S, Hamid NA, Das S, Zurinah W, Ngah W and Yusof YAM. Ginger extract (Zingiber officinale) has anti-cancer and anti-inflammatory effects on ethionine-induced hepatoma rats. Clinics, 2008; 63: 807-813.

[12] Li WG, Zhang XY and Wu Y. Anti-inflammatory effect and mechanism of proanthocyanidine from grape seeds. Acta Pharmacologic sinica, 2001; 22:1117-1120.

[13] Verma S K , Singh M, Jain P and Bordia A.. Protective effect of ginger, *Zingiber officinale* Rosc on experimental atherosclerosis in rabbits. *Indian Journal of Experimental Biology* . 2004; 42: 736-738.

[14] Abdullah N, Sast N Z M , Abu-Hasan H, Budin S B and Kamaralzaman S. Protecteve effect of the Ethanol Extract of Zingiber officinale Roscoe on Paracetamol induced Hepatotoxicity in rats. *Jurnal Sains Kesihatan Malaysia.* 2004; 2(2) : 85-95.

[15] Braunstein G D, Rasor J, Alder D, Danzer H and Wade M E. Serum human luteinizing hormone levels through normal pregnancy. American journal of obstetrics and gynecology, 1976; 126, 678-81.

[16] Odell WD, Parlow AF, Cargille CM and Ross GI. Radioimmunioassay for human FSH: physiological studies. J. Clin. Invest., 1968; 47, 2551-62.

[17] Aebi H. Catalase *in vitro*. Methods Enzymol., 1984; 105: 121-126.

[18] Habig WH, Pabst MJ and Jakoby WB. Glutathione-S-transferase the first enzyme step in mercapturic acid formation. J. Biol. Chem., 1974; 249(22): 7130-7139.

[19] Steel RGD and Torrie JH. Principles and Procedures of Statistics. 1980 5th Ed. McGraw-Hill Book Inc., New York.

[20] Khaki A, Khaki A A , Hajhosseini L, Golzar F S and Ainehchi N. The antioxidant effects of ginger and cinnamon on spermatogenesis dys-function of diabetes rats. Afr J Tradit Complement Altern Med. 2014; 11(4):1-8.

[21] Shanoon AK. Effects of *Zingiber officinale* Powder on Semen Characteristic and Blood Serum Sex Hormones Concentration in Broilers Breeder Male. International Journal of Poultry Science. 2011; 10 (11): 863-866.

[22] Morakinyo A O, Adeniyi O S and Arikawe A P . Effects of *Zingiber Officinale* on Reproductive Functions in the Male Rat . African Journal of Biomedical Research., 2008; 11: 329 – 334.

[23] Khaki A, Fathiazad F, Nouri M, Khaki AA and Ozanci CC. The effects of ginger on spermatogenesis and sperm parameters of rat. Iran J Reprod Med., 2009; 7(1):7-12.

[24] Khaki A, Farnam A, Badie AD and Nikniaz H. Treatment Effects of Onion (Allium cepa) and Ginger (Zingiber officinale) on Sexual Behavior of Rat after Inducing an Antiepileptic Drug (lamotrigine). Balkan Med J., 2012; 29: 236-42.

[25] Shalaby MA and Hamowieh AR. Safety and efficacy of Zingiber officinale roots on fertility of male diabetic rats. Food Chem Toxico., 2010; 48(10):2920-4.

[26] Riaz F, Khan UA, Ayub M and Shaukat S. Protective role of ginger on lead induced derangement in plasma testosterone and luteinizing hormone levels of male Sprague Dawley rats. J Ayub Med Coll Abbottabad., 2011; 23(4):24-7.

[27] Onwuka FC, Erhabor O, Eteng MU and Umoh IB. Protective effects of ginger toward cadmium-induced testes and kidney lipid peroxidation and hematological impairment in albino rats. J Med Food., 2011; 14(7-8):817-21.

[28] Modaresi M, Messripour M and Rajaei R. The effect of cinnamon (bark) extract on male reproductive physiology in mice. Armaghan Danesh., 2009; 14:67–77.

[29] Hafez DA. Effect of extracts of ginger goots and cinnamon bark on fertility of male diabetic rats. J Am Sci., 2010; 6:940–947.

[30] Mashhadi NS, Ghiasvand R, Hariri M, Askari G, Feizi A, Darvishi L, Hajishafiee M, and Barani A. Effect of ginger and cinnamon intake on oxidative stress and exercise performance and body composition in Iranian female athletes. Int J Prev Med., 2013; 4 (1):S31-5.

[31] Ali B H, Blunden G, Tanira MO and Nemmar A. Some phytochemical, pharmacological and toxicological properties of ginger (Zingiber officinale Roscoe): a review of recent research. Food Chem Tox 2008;46:409-20.

[32] Amin A and Hamza A A. Effects of Rosell and ginger on cisplatin- induced reproductive toxicity in rats. Asian J. Androl., 2006; 8(5): 607-612.

[33] Ghayur MN and Gilani AH. Ginger lowers blood pressure through blockade of voltage-dependent calcium channels. Dig Dis Sci. 2005; 50:1889–97.

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