

Studying the Effect of Aqueous Extract from *Curcuma Longa* on Some Parameters of Cytogenetic, Immunity and Fertility in Female Mice

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Abstract:

The research work was conducted to investigate the effect of oral administration of aqueous extract of turmeric at doses of (5, 10) mg/kg body weight for two weeks daily by determining the genotoxic effect (mitotic index), evaluation of immunological effect (IgG, IgM, IgA, C3, C4) and measuring fertility hormones (follicles stimulation hormone/FSH, lutenising hormone/LH) levels with histological examinations of female albino swiss mice ovaries in comparison with control (normal saline). A clear effect in increasing mitotic activity was revealed for both doses in comparison with control. Results also showed a significant increase in the value of all immunological parameters at both doses, in comparison with control. Also, obvious raise was seen in the levels of FSH and LH hormones for both doses when compared with normal saline treated mice with no significant damage seen in female ovaries tissue, in fact, there were certain changes in mice ovaries tissue which were represented by increasing in the numbers of primary and secondary follicles and in the numbers of corpus luteum at both doses also.

Key words: turmeric, curcumin, mitotic index, immunity, fertility

Introduction:

Turmeric, a spice obtained from the rhizome of *Curcuma longa* Linn (Zingiberaceae), has been regularly used for its coloring, flavoring and medicinal properties[1]. *Curcuma longa* rhizomes contain approximately volatile oil; composed mainly of monoterpenes, curcuminoids; composed mainly of curcumin, minerals, carotene and vitamin C [2]. Curcumin, the active principle of turmeric, is commonly used as a coloring agent in foods, drugs and cosmetics, and has a wide range of effects[3]. The continuing research indicates that turmeric and its active compound 'curcumin' are unique antioxidants, antimutagenic, antitumorogenic, anticarcinogenic,

anti-inflammatory, antiarthritics, antimicrobial and immunomodulatory properties as reviewed recently[4,5].

The immunoglobulins, also known as antibodies, are a family of proteins that exist in the plasma. The immunoglobulin family includes immunoglobulin "A" (IgA), immunoglobulin "G" (IgG), immunoglobulin "M" (IgM), immunoglobulin "D" (IgD), and immunoglobulin "E" (IgE). All of the immunoglobulins play a role in the immune system's defense mechanisms. The immune system manufactures the immunoglobulins in response to exposure to a foreign invader. After exposure to a foreign invader, such as a specific virus, bacteria, or toxin

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produced by an organism, a certain type of lymphocyte (a type of white blood cell) produces the immunoglobulins. then the immunoglobulins level can be measured in the blood[6].

Complement analysis in the clinic is usually associated with the quantification of C3 and C4 and screening for complement activity together with complement activation products. These analyses have been available in routine diagnostic laboratories for decades. In recent years, however, the field of complement analysis has expanded considerably, with the introduction of novel assays to detect complement activation products, and spreading still further towards genetic analysis to reveal the basis of complement deficiencies and identify mutations and polymorphisms associated with some diseases[7].

Fertility hormones, FSH (Follicle Stimulating Hormone) is a hormone secreted by the pituitary gland in the brain. It stimulates the follicles in the ovaries to ripen several eggs. FSH also readies the mammary glands for milk production. In men, the FSH initiates sperm production. While LH (Lutenising Hormone) is secreted by the pituitary gland to stimulate ovulation that is, the release of the egg or ovum from the follicles. LH secretion signals the remnants of the follicle to change into the corpus luteum. The corpus luteum then begins producing [progesterone](#) and [estrogens](#) [8].

The aim of the present study was to investigate the effect of aqueous extract from turmeric on some parameters of cytogenetic, immunity and fertility in female mice.

Materials and Methods:

All the chemicals were obtained from Sigma Chemical Co. (USA) and BDH (England).

Experimental Animals: Three groups of female albino Swiss BALB/c mice, which were obtained from the Biotechnology Research Center / AL-Nahrain University, were used in this study. Their ages were ranged between (8-12) weeks and weighting (25-30) gm. They were divided into subgroups, and each group was putted in a separate plastic cage. The cages were kept in a room with (23-25) C° temperature. The animals were fed with a suitable quantity of water and complete diet.

Administration of Experimental Animals:

The animals in this experiment were treated with a cumulative dose of turmeric for 14 days. The main aim of this experiment was to evaluate the acute treatment effect of turmeric in normal mice. The mice were divided into three experimental groups, each group consisted of (5) mice and to which the turmeric was administered orally.

Group I: Negative control (5mice), treated with (0.1ml) of normal saline.

Group II: turmeric treatment (5mice) treated with (0.1 ml) of (1mg /Kg)

Group III: turmeric treatment (5mice), treated with (0.1 ml) of (5mg /Kg).

The animals were monitored for apparent signs of toxicity for 14 days. Then they were sacrificed on the 15th day after administration and the blood was separated to measure the levels of (IgG, IgM, IgA, C3, C4) and (FSH, LH) fertility hormones by using a specific measuring kits. After that the

ovaries were collected and fixed in 10% buffered formaldehyde solution.

Preparation of aqueous extract: water extraction of turmeric was prepared by boiling (100)gm in (1000)ml distilled water over low flame for (15)minutes. The flask was then plugged and removed from the heat and allowed to cool. After cooling the content of the flask was filtered and dried to prepare the required concentrations[9].

Chromosomal preparation from somatic cells of the mouse bone marrow: This experiment was done according to [10]. Each animal was injected with 0.25ml of colchicine with a concentration of (1mg/ml) intraperitoneally (I.P) 2hr before sacrificing the animal, Then the animal was sacrificed by cervical dislocation and fixed on its ventral side on the anatomy plate and the abdominal side of the animal and its thigh region were swabbed with 70% ethanol. The femur bone was then taken and cleaned from the other tissues and muscles and gapped from the middle with a forceps in a vertical position over the edge of the test tube, and by sterile syringe 5ml of PBS were injected so as to wash and drop the bone marrow in the test tube. The test tube was taken and centrifuged at speed of 2000 rpm for 10min. After that the supernatant was removed and 5ml of potassium chloride (0.075) M was added as a hypotonic solution, then the test tubes were left for 30min in the water bath at 37C ° and shaken from time to time. The tubes were then centrifuged at 2000 rpm for 10min and the supernatant was removed and the fixative solution was added (as drops) on the inside wall of the test tube with the continuous shaking, the volume was fixed to 5ml and the content shaken well. The tube was kept at 4C°

for 30min to fix the cells. After that the tubes were centrifuged at 2000 rpm for 10min. The process was repeated three times and the cells were suspended in 2ml of the fixative solution. By a pasture pipette, few drops from the tube were dropped vertically on the chilled slides from a height of 3 feet at a rate of (4-5) drops to give the chance for the chromosomes to spread well. Later the slides were kept to dry at room temperature, and then stained with Giemsa stain and left for 15min and washed with D.W.

Assay measurements of hormones: Serum hormones (FSH, LH) concentrations were evaluated with a Bio merieux Italia S.P. a vidia campigliano, 58 50015-point A EMA (F₁) Italia miniVIDAS, following the manufacturer's recommendations.

Assay measurements of immunoglobulins and complements: serum levels of (IgG, IgM, IgA, C3, and C4) were evaluated by using radial immunodiffusion plate, following the kit manufacturer's method.

Histological Examinations: This was performed by using method of [11]. At the time of death, mouse organs ovaries were taken for histopathological examination. The perfuse-fixed ovaries placed in Bouin fluid overnight, and processed for routine paraffin embedding. The ovaries were cut into 5-µm sections. Three serial sections per ovaries were mounted on slides, deparaffinized, rehydrated, and stained with hematoxyline - eosin stain. Sections of the ovaries were examined by light microscopy; primary and secondary follicles and corpus luteum diameters were assessed in each ovary using a previously calibrated micrometer eyepiece.

Statistical Analysis: Data were analyzed by 1-way analysis of variance with ANOVA- test. Data are presented as means \pm SE. The level of significance was $P < .05$. [12].

Results and Discussion:

After the mice have been orally given two doses [5,10] mg/kg of the water extract from the dried rhizome of *Curcuma longa*, neither signs of toxicity nor death of mice were observed during the 14 days of the experimental period, similar results were also obtained by many authors [13,14,15], in which they showed that, no toxic effects due to feeding turmeric or curcumin in rat, guinea pig or monkey were recorded. Significant difference in mitotic percentage between treated and untreated (control) animals were occurring as shown in Table 1. A clear effect in increasing mitotic activity was revealed for both concentrations (61.66, 70.00)% respectively in comparison with control (51.16)%. The turmeric (*Curcuma longa* Linn (Zingiberaceae)) has traditionally been used as both spice and medicine. It contains small quantities of chemopreventive compounds such as B-carotene, curcumin, volatile oils. The antimutagenic activity of turmeric could be related to the large number of these potent chemopreventive compounds and especially curcumin which were shown to be a promising antimutagenic compound [16,17].

However, similar results were also obtained in which powdered

turmeric were given in combination with genotoxic agents and it was shown to be so effective in reducing the mutational events induced by these agents either by suppression of metabolic activation or interaction with the active groups of mutagens and this suggest to be the mechanism by which the turmeric exert its antimutagenic property [18,19].

Table (1): Cytogenetic effects of *Curcuma longa* in comparison with control (normal saline) on mouse bone marrow cell.

Groups	Mitotic index (mean \pm SE)
Control	A 51.16 \pm 3.76
Curcuma 5mg	BC 61.66 \pm 2.51
Curcuma 10mg	C 70.00 \pm 1.73

*Differences A, B, C are significant ($P < 0.05$) to compared rows.

To determine the immunomodulatory effect in mice treated with the extract, immunological parameters were examined as presented in Tables (2). The concentration of immunoglobulins and complements (IgG, IgM, IgA, C3, C4) in the treated mice with (5 and 10)mg/kg of the extract was higher than that of the control group. Results show a significant raise in the levels of them (1105, 151.4, 229.3, 252.8, 342.7 and 1126, 158.41, 240.8, 263.9, 358.9)mg/dl respectively at both doses in comparison with control (1020, 130.6, 213.62, 224.32, 320.9)mg/dl.

Table (2): Immunomodulatory activity of *Curcuma longa* in comparison with control (normal saline) in mice.

Groups	Immunoglobulin mg/dl (mean \pm SE)				
	IgG	IgM	IgA	C3	C4
Control	A 1020 \pm 84.61	A 130.6 \pm 26.9	A 213.62 \pm 17.51	A 224.32 \pm 208	A 320.9 \pm 40.2
Turmeric 5mg	C 1105 \pm 96.37	C 151.4 \pm 30.2	B 229.3 \pm 18.72	C 252.8 \pm 17.6	B 342.7 \pm 39.0
Turmeric 10mg	C 1126 \pm 78.76	C 158.41 \pm 22.32	C 240.8 \pm 23.26	D 263.9 \pm 19.48	C 358.9 \pm 41.3

*Differences A, B, C, D are significant ($P < 0.05$) to compared rows.

These results were come in agreement with [20,21,22,23] in which the researchers show that both turmeric or curcumin alone is a potent immunomodulatory agent that can modulate the activation of T cells, B cells, macrophages, neutrophils, natural killer cells, and dendritic cells. The spice were seen to poses an anti-carcinogenic and anti-inflammatory activity and may act as immunorestorer agent through altering the immune system by increasing the number of immune cells and bone marrow cellularity and this in turn lead to increase in the level of immunoglobulins and complements in additions to other types of immune system cells. Thus the turmeric had no immunotoxic effect and may be considered as immunologically safe compound.

However, with fertility aspect, turmeric shows promising results. A significant raise in the levels of fertility hormones (FSH and LH) was seen after treatment with the two doses of the extract when compared with control treated mice as shown in table (3). The levels of FSH were (2.01, 2.63) mIU/m while LH (1.99, 2.62) mIU/m at the two doses respectively when compared with normal saline treatment (1.46, 1.32) mIU/m.

Table (3): Fertility activity of *Curcuma longa* in comparison with control (normal saline) in mice.

Groups	FSH mIU/m (mean±SE)	LH mIU/m (mean±SE)
Control	A 1.46±0.06	A 1.32±0.63
Turmeric 5mg	B 2.01±0.08	B 1.99±0.30
Turmeric 10mg	C 2.63±0.62	C 2.62±0.61

*Differences A, B, C are significant (P<0.05) to compared rows.

Moreover, these observations were further investigated by the histopathological assessment of the female ovaries tissues. The results

showed that the water extract of *C. longa* did not produce a significant damage in these tissues, however, significant changes were seen in the number of primary and secondary follicles and corpus luteum in the turmeric treated mice when compared with the control treated mice as shown in table (4). After oral administration of the two extract doses, the number of the primary follicles was (5.20, 6.00) and secondary follicles (7.00, 8.02) respectively, while control was (4.36, 6.43). On the other hand, the number of corpus luteum was (5.20, 5.86) at both doses respectively, while normal saline treated mice showed (4.40).

Table (4): Effect of *Curcuma longa* on primary and secondary follicles and corpus luteum in comparison with control (normal saline) in mice.

Groups	No. of primary follicles (m±SE)	No. of secondary follicles (m±SE)	No. of corpus luteum (m±SE)
Control	A 4.36±0.82	A 6.43±1.22	A 4.40±0.86
Turmeric 5mg	C 5.20±1.08	B 7.00±2.12	B 5.20±0.96
Turmeric 10mg	D 6.00±1.32	C 8.02±1.94	C 5.86±1.30

*Differences A, B, C are significant (P<0.05) to compared rows.

Turmeric was shown to have powerful antioxidant [5,24], and since many studies show a strong relation between antioxidants and fertility inductions [25,26,27] and between increased free radicals and reduced fertility [28]. These studies showed that the imbalance between antioxidant defense and free radical activity is more evident in the infertility condition, thus turmeric extract shows significant effect in increasing fertility in mice. Moreover, similar studies were also conducted to investigate the effect of powdered turmeric on fertility and reproduction in rate and they proven that; there were no adverse toxicological effects on the reproductive capacity of rats that received dietary concentrations of

curcumin up to 500 mg/kg for two successive generations but in fact, turmeric had enhance their fertility [29,30].

References:

1. Ammon, H.P. and Wahl, M.A. 1991. Pharmacology of *Curcuma longa*. *Planta Med.* 57: 1-7.
2. leung, A. Y. and Foster, S. 1996. encyclopedia of common natural ingredients used in food and cosmetics. 2nd Edn., New York, Merk and Sons Inc., pp: 499-501.
3. Anto, R. J.; George, J.; Babu, K. V.; Rajasekharan, K. N. and Kuttan, R. 1996. Antimutagenic and anticarcinogenic activity of natural and synthetic curcuminoids. *Mutat. Res.* 370: 127-131.
4. Majeed, M.; Badmaev, V.; Shivakamar U. and Rajendran, R. 1995. Curcuminoids antioxidant phytonutrients Nutriscience Publisher Inc., Piscata way, Newjersy.
5. Miquel, J., A.; Sempere, J. M. and Dias-Alperi, R. A. 2002. Curcuma antioxidants: pharmacological effects and prospects future clinical use. A review: *Arch.Gerontol. Geriaty*, 34: 37-46.
6. Von König C. H., Finger H. and Ormaycht D. H. 1979. Immunoglobulins and other plasma proteins in late pregnancy (author's transl). *Immun Infect.*; 7(3): 89-92.
7. Tom E. M.; Sakari J.; Lennart T. and Bo N. 2007. Complement analysis in the 21st century. *Molecular Immunology*, 44(16): 3838-3849.
8. Web site: WikiAnswer. Com. What is FSH and LH Pituitary Hormones?
9. Abraham, S., Abraham, S.K. and Radhamony, G. 1976. Mutagenic potential of the condiments, ginger and turmeric. *Cytologia* 41: 591-595.
10. Allen, J. W.; Shuler, C. F.; Memnders, R. W. and Olatt, S. A. 1976. A simplified technique for in vivo analysis of sister chromatid exchange using 5-bromodeoxyuridine tablets. *Cytogen. Cell Genet.*, 18: 231-237.
11. Bancroft, J. D. and Stevens, A. S. 1992. Theory and Practice of Histological Techniques. 2nd (ed.). Churchill Living Stone, Edinburgh, London.
12. Al-Mohammed N. T.; Al-Rawi K. M.; Younis M. A. and Al-Morani W. K. 1986. Principle of Statistics. J. Al-Mousl University (in Arabic).
13. Quian, Z. C.; Liu, J. Y.; Zhao, S. R.; Yu, L. H; Zhang, D. Y. and Wei., W. H. 1981. Prophylatic effect of active immunization with curcuma aromatic treated tumour cells-exploration of mechanism of action of curcuma aromatica. *Yaoxue Xueboa*, 16: 892-896.
14. Zeng, L. L.; Wang, G. Y.; Wang D. X. and Chen, C. H. 1982. Studies on the active ingredient of curcumin and its effects. *Yaoxue Xueboa*, 8: 946-950.
15. Li, B. and N. Liang, 2003. Advances in the clinical application and experimental study of curcuma zedoaria oil preparations. *Zhongyaocia*, 26: 68-71.
16. Rao, C. V.; Abraham, R.; Simi, B. and Reddy, B. S. 1995. Chemoprevention of colon carcinogenesis by dietary curcumin, a naturally occurring plant phenolic compound. *Cancer Research*, 55: 259-266.
17. Anto, R.J., George, J., Babu, K.V.D., Rajasekharan, K.N. and Kuttan, R. 1996. Antimutagenic and anticarcinogenic activity of natural and synthetic curcuminoids. *Mutation Research*, 370: 127-131.
18. Maria C. P.; Araújo, F.; Luz, D.; Sergio, N. and Catarina, S.1999.

- Effect of turmeric and its active principle, curcumin, on bleomycin induced chromosomal aberrations in Chinese hamster ovary cells. *Genetics and Molecular Biology*, 22(3): 407-413.
19. Ibrahim, M.; Khalid, M.; Abeer, F. and Osama, M. 2006. Protection by turmeric and myrrh against liver oxidative damage and genotoxicity induced by lead acetate in mice. *Bas. Clini. Pharm. Toxicol.*, 98(1): 32-37.
 20. Hadida, Y.; Tamal M.; Pragya M. and Ashim K. 2005. Turmeric Mediated Activation of Lymphocytes and Induction of Apoptosis of Tumor Cells. *Indian J Med Res.*, 3: 60-67.
 21. Gautam, S.C.; Gao, X. and Dulchavsky, S. 2007. Immunomodulation by curcumin. *Adv. Exp. Med. Biol.*, 595:321-41.
 22. Jagetia, G. C. and Aggarwal, B. B. 2007. "Spicing up" of the immune system by curcumin. *J. Clin Immunol.*, 27(1): 19-35.
 23. Sa, G. and Das, T. 2008. Anti cancer effects of curcumin: cycle of life and death. *Cell Div.*, 3:14-18.
 24. Padmaja, S. and Raju, T. N., 2004. Antioxidant effect of curcumin in selenium induced cataract in Wistar rats. *Indian J. Exp. Biol.*, 42: 601-603.
 25. Ruder, E. H; Hartman, T. J. and Goldman, M. B. 2009. Impact of oxidative stress on female fertility. *Current Opinion in Obstetrics and Gynecology.*, 21(3): 219-222.
 26. Vural, P.; Akgül, C.; Yildirim, A. and Canbaz, M. 2000. Antioxidant defense in recurrent abortion. *Clin Chim Acta.* 2000 May;295(1-2):169-77.
 27. Elizabeth H. R.; Terry J. H.; Jeffrey B. and Marlene B. G. 2008. Oxidative stress and antioxidants exposure and impact on female fertility. 15 (4): 2893-2903.
 28. Behrman HR, Kodaman PH, Preston SL, Gao S. 2001. Oxidative stress and the ovary. *J Soc Gynecol Investig.*, 8(1): 40-42.
 29. Bhavanishankar, T. N. and Murthy, V. S. 1987. Reproductive response of rats fed turmeric (*Curcuma longa* L) and its alcoholic extract. *J. Food Sci. Technol.*, 24: 45-49.
 30. Ganiger, S.; Malleshappa, H.; Krishnappa, H. and Geetha, R. 2007. A two generation reproductive toxicity study with curcumin, turmeric yellow, in Wistar rats. *Food Chem. Toxicol.*, 45: 64-69.

دراسة تأثير المستخلص المائي لنبات الكركم على بعض معاملات الوراثة الخلوية والمناعة والخصوبة في اناث الفئران

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الخلاصة:

تم اجراء هذا العمل البحثي بهدف التحري عن تأثير المستخلص المائي لنبات الكركم المعطى عن طريق الفم وبجرعتين (10, 5) ملغم/كغم من وزن الجسم ولمدة اسبوعان يوميا من خلال حساب التأثير السمي الوراثي (معامل الانقسام الخيطي) ، وتقييم التأثير المناعي بقياس معدل المعاملات المناعية (IgG, IgM, IgA, C3, C4) وقياس معدل الهرمونات الانثوية (FSH, LH) مصحوبة بفحص التغيرات المرضية في مبايض الاناث المعاملة بالمستخلص ومقارنتها مع السيطرة (الدارئ الملحي). أظهرت النتائج وجود تأثير واضح في زيادة نشاط معدل الانقسام الخيطي ولكلا الجرعتين بالمقارنة مع السيطرة. كذلك اظهرت النتائج حدوث زيادة معنوية في جميع قيم معاملات المناعة لكلا الجرعتين بالمقارنة مع السيطرة . لوحظ ايضا حدوث ارتفاع ملموس في معدل هرموني FSH و LH وايضا عند كلا الجرعتين بالمقارنة مع الفئران المعاملة بالدارئ الملحي وفي الوقت نفسه لم يتم مشاهدة حدوث اي تلف في نسيج مبايض الاناث ولكن كان هنالك بعض التغيرات والتي تمثلت بحدوث زيادة في عدد الجريبات الاولية والثانوية والاجسام الصفراء.