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The Inhibitory Effect of Aqueous Extract of Coriander (*Coriandrum sativum L.)* Leaves on the Activity of Male Reproductive System of Albino Mice

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Abstract

The aim of present study to investigate the effect of *Coraindrum sativum* leaves extract on reproductive activity of male albino mice .Thirty male mice with age of 80-100 day and weight between 25-30 g were divided into three groups: group 1 (untreated), group 2 and 3 were administrated orally for 30 days with aqueous extract of *Coraindrum sativum* leaves at dose 125 and 250mg/kg.b.w. respectively.

The following parameters were evaluated: serum testosterone levels, testes weights, sperm characteristics [motility, viability, spermatozoa, morphology and concentration] and histology changes of the testis. The results showed that the treatment caused highly significant degrease ($P<0.01$) in testosterone levels and the weight of testes associated with highly significant decrease ($P<0.01$) in sperm progressive motility, viability and concentration while the percentage of abnormal sperms was increased significantly. Testicular histology showed gradual degeneration in the population of germ cells lining seminiferous tubules and also degeneration in the interstitial tissue of Leydig cells.

In conclusion, the results indicate that *Coraindrum sativum* leaves extract at dose 125 and 250 mg/kg.b.w. has antifertility effect in male albino mice.

Keywords: *Coraindrum sativum*, Testosterone, Leaves extract, Testes, Sperms.

التأثير التثبيطي للمستخلص المائي لأوراق الكزبرة على فعالية الجهاز التكاثري الذكري للفئران البيض

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الخلاصة

تهدف الدراسة الحالية إلى تقصي تأثير المستخلص المائي لأوراق الكزبرة في الفعالية التكاثرية لذكور الفئران البيض، شملت الدراسة 30 فأراً، تراوحت أعمارها من 80–100 يوم وأوزانها من 25–30 غرام . قسمت الفئران إلى ثلاث مجاميع، المجموعة الاولى مجموعة السيطرة والمجموعة الثانية والثالثة (المجموعة المعاملة) جرعت فموياً لمدة 30 يوماً بالمستخلص المائي لأوراق الكزبرة بجرعة 125 و 250 ملغرام لكل كيلو غرام من وزن الجسم على التوالي. تم تقدير مستوى هرمون التستوستيرون في مصل الدم ، كما تم تقييم اوزان الخصى وحددت بعض معالم النطاف المتمثلة بقيم الحركة التقدمية ونسبة النطاف الحية ونسبة النطاف السوية والعدد الكلي للنطاف، كما أجريت الدراسة النسجية للخصى. أظهرت النتائج حدوث انخفاض معنوي عالي($P<0.01$) في مستوى هرمون التستوستيرون وأوزان الخصى ،كما انخفضت معنوياً نسبة الحركة التقدمية للنطاف ونسبة النطاف الحية بالإضافة إلى الانخفاض في العدد الكلي للنطاف في حين ارتفعت معنوياً النسبة المئوية للنطاف غير السوية. أظهرت المقاطع النسجية للخصى تنكس في مجتمعات الخلايا الجرثومية المبطنة للنبيبات الناقلة المني وضمور في النسيج الخلالي لخلايا ليدك. أشارت النتائج إلى امتلاك مستخلص أوراق

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الكزبرة بجرعة 125 و 250 ملغرام لكل كيلو غرام من وزن الجسم خواصاً مضادة للخصوبة في ذكور الفئران البيض.

Introduction

The use of complementary traditional medicine which includes herbal medicines as a remedies for human diseases has expanded rapidly attributable to affordability, accessibility and efficacy [1]. Various medical plants are used by the population in nature or in the form of pharmaceutical preparation and their use has grown worldwide [2]. World health organization (WHO) estimates that approximately 80% of the developing world's population is using traditional medicine for primary healthcare [3]. However, there is a prevalent misunderstanding that herbal medicines are devoid of toxic effects [4]. Bioactive compounds derived from medicinal plants can be useful but might have serious dose related side effects [5].

Coraindrum sativum L. (Apiaceae) is a annual herb, the fresh leaves and dried seeds of which a common component of middle eastern, Mediterranean, Indian, Latin American, African and Southeast Asian cuisines [6]. It's commonly known as coriander in English [7] and famous as cilantro [8].

Experimental studies using different methodologies demonstrated that *Coraindrum sativum* leaves contain essential oil, flavonoids (quercitrin, isoquercitrin), polyphenols (rutin, caffeic acid, ferulic acid, galic acid and chlorogenic acid). Other molecules are found like linalool (Monoterpene alcohol) linoleic acid, sugars and proteins [9,10]. The methanolic and aqueous extracts of coriander leaves have been assessed for total phenolic content [11], [12] demonstrated that monoterpenoid, monoterpenoid glucose sulfate and other glycosides are water soluble compounds.

Alphatic compounds (90%) mainly comprised of aldehydes and alcohol predominate in the steam-volatile oil extracted from leaves of *Coraindrum sativum* are responsible for its peculiar ftid-like aroma [13]. In addition to its culinary value coriander is known for its wide range of healing properties. *Coraindrum sativum* leaves have been used as antispasmodies, anorexia, dyspeptic and appetizer [14]. Moreover it has been shown to possess antioxidant [15], antimicrobial [16], antihyperlipidemic [17], antidiabetes [18] and memory enhancing effect as reported by [19].

Earlier study revealed that the aqueous extract of fresh coriander seed has a toxic effect on female reproductive system [20]. Oral supplementation of 250 mg and 500 mg/kg in rats resulted in dose dependent decrease in implantation due to decreased progesterone level.

The aim of this study is to evaluate the effect of aqueous extract of *Coraindrum sativum* leaves in male reproductive function in mice such as sperm characteristics, testosterone secretion and histopathological of testes.

Materials and methods

Plant preparation and extraction

Coraindrum sativum leaves were collected from local markets in Baghdad city washed with distilled water, leaves were sliced in to small pieces and ground with pestle to produce a fine paste. Coriander leaves aqueous extract were prepared by mixing limited weight of the paste in 10 ml of distilled water and then the mixture was filtered by cleaning cloth to prepare the extract at dose level 125, 250 mg/kg.b.w. Fresh extract were administrated to mice immediately [21, 22].

Animals

Thirty males of Swiss albino mice (*Mus musculus*) their age between 80-100 day and their weight between 25-30g were used in the investigation. Mice were maintained under hygienic condition in well ventilated room and had free access to maintenance food and water *ad libitum*.

Treatment and Dosage

The animals were randomly devided in to three groups of ten animals in each group and treated as follows.

Group-1: Control mice that received orally by gavage needle 0.1ml of tap water daily for 30 days.

Group-2: Male mice treated orally by gavage needle with 0.1 ml of coriander leaves aqueous extract at dose 125 mg/kg of body's weight daily for 30 days.

Group-3: Male mice treated orally by gavage needle with 0.1 ml of coriander leaves aqueous extract at dose 250mg/kg.b.w. daily for 30 days.

Blood sample collection and organ

On day 31 of the experiment all animals were sacrificed. Blood samples from each mouse was collected via cardiac puncture in to a sterilized sample tube and was allowed to clot at room

temperature, the samples were centrifuged at 3000 xg for 15 min and sera were collected and stored at 20°C. Both tests and epididymis immediately dissected out and cleared of their adhering tissue. Testes weight were measured and fixed in formalin 10% for histological analysis.

Hormonal study

Testosterone level in serum samples collection was measured by radio immunoassay system.

Sperm collection and analyses

The epididymis was carefully separated from the testis and the cauda severed from its remaining part. Cauda was finely minced by anatomical scissors in 1 ml of isotonic saline at 37°C in a petridish, it was completely squashed by tweezers for 1 min to expel the sperms to the petridish. Sperms parameters were assessed according to World Health Organization [23], progressive motility was tested at once. Using a 100-point scale for linear movement the data were collected from 5 different fields in each sample and expressed in percentage of total cells.

A viability study was done using eosin/nigrosin stain and the average percentage of vital (unstained) sperms was calculated. Sperms morphology were done by the same stain and air-dried the slides were examined under the microscope using 100x objectives under oil immersion, the abnormal sperm cells were counted and the percentage calculated. Sperm concentration was determined using standard hemocytometric method. The dilution rate was 1:200 and the concentration was expressed per ml.

Histological examination

For each testis two slides of 10 μm sections were prepared according to [24] and stained with hematoxylin-eosin.

Statistical analysis

Data were expressed as mean ± standard error of mean (SEM). Statistical significance between the various groups was determined using ANOVA [25].

Results

Serum testosterone levels

Means serum testosterone levels of mice treated with 125 and 250mg/k.g.b.w for the extract of *C. sativum* significantly decrease ($P<0.01$) as compared with control Table-1.

Testes weights

The administration of aqueous extract of *C.sativum* leaves for 30 days at dose 125 and 250mg/k.g.b.w. caused highly significant decrease ($P<0.01$) in testes weight compared with control Table-2.

Sperm parameters

Oral administration *C. sativum* leaves extract at dose 125 and 250 mg/k.g.b.w. highly significantly reduced ($P<0.01$) sperm progressive motility. There was also a highly significant decrease ($P<0.01$) in percentage of viability (Live sperm) compared with control. The percentage of abnormal sperms was highly significantly increased ($P<0.01$) in animals of treated groups.

Daily administration of the extract for 30 days caused highly significant decrease ($P<0.01$) in the mean epididymal sperm counts compared with control Table-3.

Table 1- Effect of *C. sativum* Leaves extract on serum testosterone levels ng/ml.

Control	*C. sativum* 125 mg/k.g.b.w	*C. sativum* 250 mg/k.g.b.w
2.52 ± 0.04 A	1.95 ± 0.2 B*	1.79 ± 0.2 B*

Data expressed as Means ± SEA.

*B significantly different from the control at ($P<0.01$). n=10

Table 2- Effect of *C. sativum* leaves extract on testes weights (mg/100g b.w.).

Control	*C. sativum* 125mg/k.g.b.w	*C. sativum* 250/k.g.b.w
0.32 ± 0.04 A*	0.27 ± 0.03 B*	0.23 ± 0.04 B*

Data expressed as Means ± SEA.

*B significantly different from the control at ($P<0.01$). n=10

Table 3- Effect of *C. sativum* Leaves extract on sperms parameters.

Sperm parameters	Control	*C. sativum* 125 mg/k.g.b.w	*C. sativum* 250 mg/k.g.b.w
S.motility%	70 ± 3.6 A	60 ± 4.8 B*	54 ± 4.9 B*
S.viability%	82 ± 4.5 A	75 ± 4.8 B*	71 ± 5.1 B*
Abnormal sperms%	26 ± 2.1 A	35 ± 3.1 B*	40 ± 5.1 B*
S.concentration X10^6/ml	46 ± 3.6 A	38 ± 5.4 B*	33 ± 2.7 B*

Data expressed as Means ± SEA.
*B significantly different from the control at (P<0.01). n=10

Histologic evaluation

Administration of 125 and 250 mg/k.g.b.w of *C. sativum* leaves extract caused damages to the seminiferous epithelium characterized by varying degrees of degeneration and disorganization within the tubules and the interstitial cells, reduced spermatogenesis (Maturation arrest) Figures-2, 3 compared to normal testicular structure in the control group Figure-1.

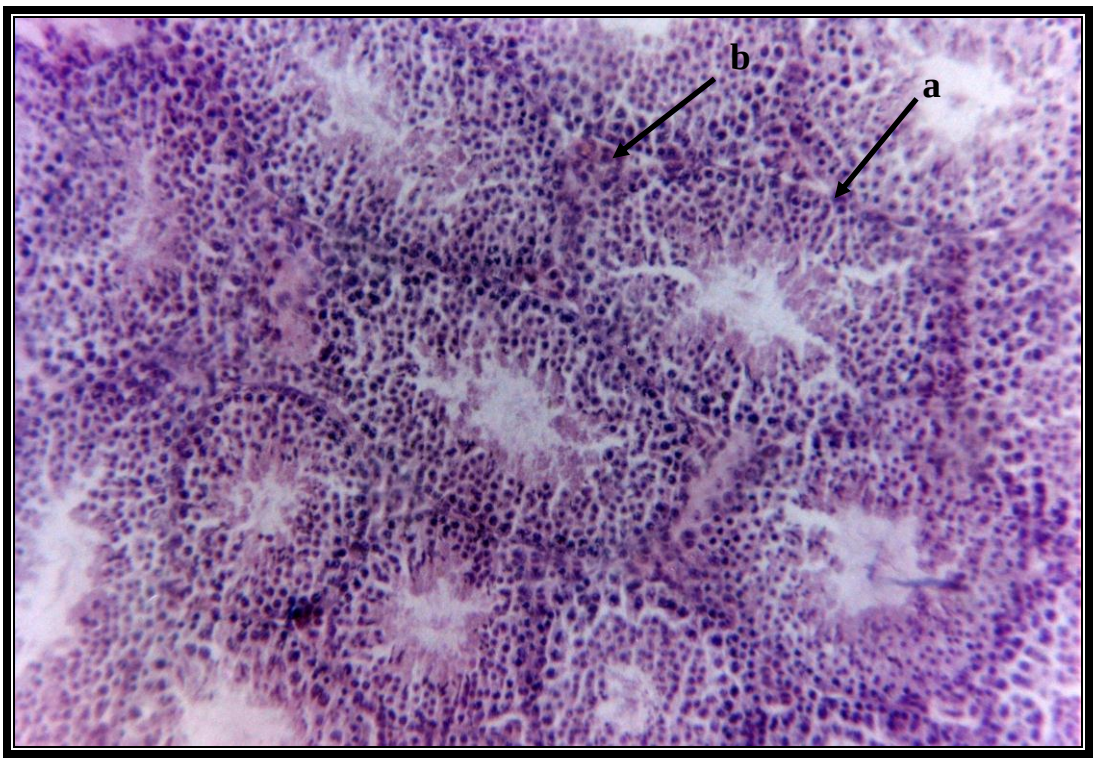

Figure 1- Cross section in testes of control group showing normal layers of germ cells within seminiferous tubules(a), normal interstitial cells of Leydig(b) (H&E 100x).

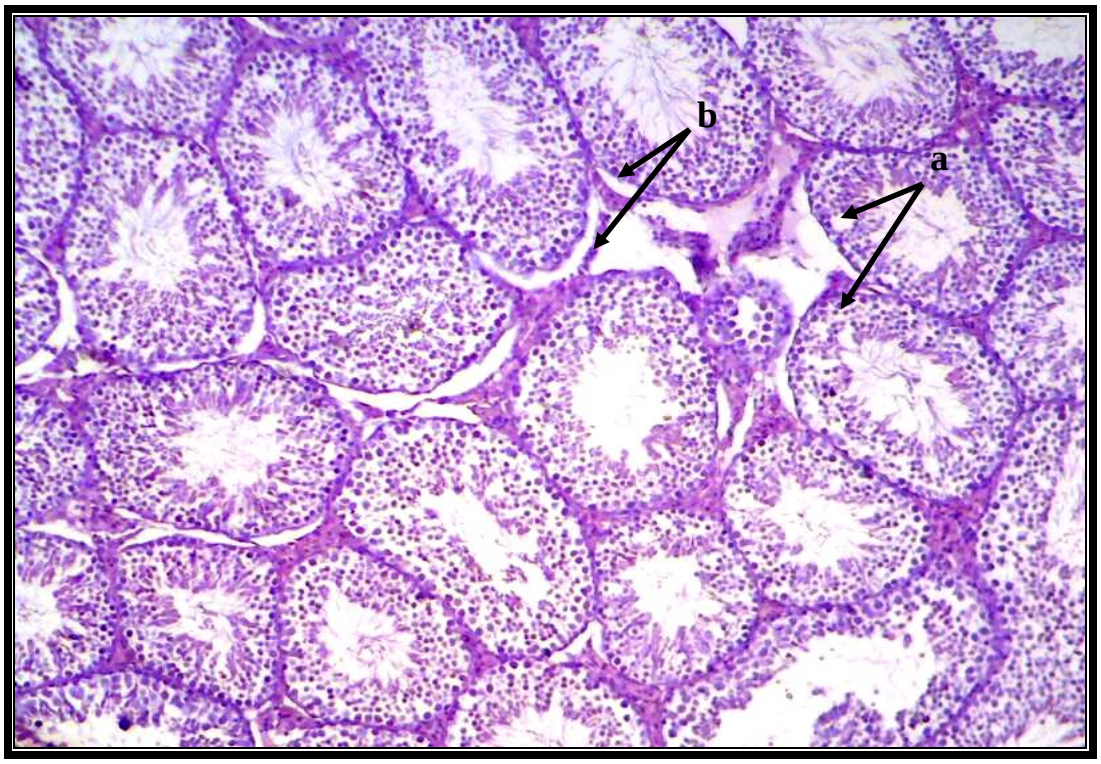

Figure 2- Cross section in testes of mouse treated with 125 mg of *C. sativum* extract showing degree of vacuolation in germinal epithelium lining seminiferous tubules(a), separation of basementmembrane from germ cells(b). (H&E100x).

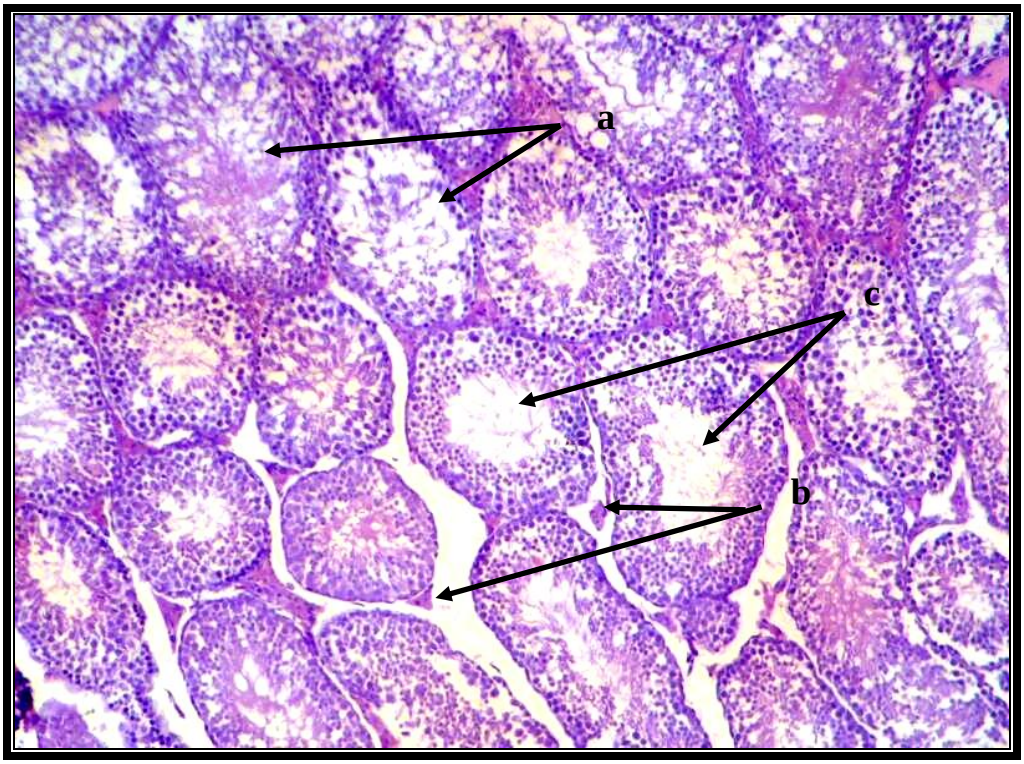

Figure 3- Cross section in testes of mouse treated with 250 mg of *C. sativum* extract show marked degeneration ing in the seminiferous epithelium (a) , interstitial of leydig cells (b) and reduce in sperm numbers(c) (H&E100x).

Discussion

Although *Coriandrum sativum* is a widely used plant in traditional medicine little is known about its safety. In traditional medicine plant extracts are prepared as aqueous suspensions such us infusions, decoctions and poultices [26, 27] in view of the above we conducted this work to examine the effects of aqueous extract of coriander Leaves on some reproductive parameters in male albino mice.

The results of the present study suggested that the aqueous extract of *Coraindrum sativum* leaves extract at dose 125 and 250 have a deleterious effect on male reproductive functions, sufficient to cause, reversible infertility in male mice.

Al-Suhaimi [28] reported that *C. sativum* did not appear to exert negative effect on testosterone levels and reproductive functions after treated rabbits with *C. sativum* seed extract for 7 days. One reason for this discrepancy in the studies that coriander leaves and seeds did not contain the same active compounds. The phytochemicals of seed and leaves are completely different [13]. Mono and poly unsaturated fatty aldehydes although minor components in seed oil coriander leaf oil contains these aldehydes as main constituents [29] another reason could be related to the type of preparations used, dose and method of administration, type of animals and duration of experiment. Serval abnormal histological alteration seen in the testes of the treatment groups, ranges from degeneration and disruption of germ cells lining seminiferous tubules and also the degeneration of the Leydig cells compared with control group. This histopathological result suggesting that the administration of *C. sativum* leaves extract for a long period were capable of permeating the blood-testis barrier and loss it biological control [30].

The daily treatment of coriander extract for 30 days resulted in reduction in serum testosterone levels. Coriander leaves showed cholesterol-lowering effect [31], cholesterol is most important precursor in the synthesis of steroid hormones like testosterone and its level is related to fertility [32]. Moreover the deformation of Leydig cells further indicates the inefficiency of these cells to synthesize testosterone [33].Significant decrease in the mean testicular weight in animals treated with *C. sativum* extract at dose 125 and 250 were observed. These results were corroborated by various degrees of degeneration in the histologic sections of testes and decreased in testosterone levels. Testosterone was necessary for development, growth and normal function of the testes and male accessory reproductive glands [34].

The present study show reduction in the progressive epididymal sperm motility of treated groups. Sperm motility depends on the coordinated propagated flagella wave. Fructose utilization and glucose oxidation are important means by which spermatozoa derive energy for their motility [29, 35] *C. sativum* Leaves had been shown to possess hypoglycemic and antihyperglycemic activity [36]. The reduction in motility recorded in this study could be due to the glucose lowering properties of this plant.

Epididymis normally provided a favorable milieu for acquisition of fertilizing ability and viability [37]. The decrease in sperm viability and the increase in abnormal sperm count in treated mice in this study suggested that the action of the extract could target the internal milieu of the epididymis [38]. Reduction in total number of epididymal sperm count in treated mice could also a result of description of seminiferous tubules as observed in the histological section of testes.

The arrest of spermatogenesis possibly occurred as a consequence of reduction in serum level of testosterone which had been shown to be essential for the completion of meiotic division during spermatogenesis [39].

References

1. Arthur, F. K. N, Woode, E., Terlabi, E. O. and Larbie, C. **2011**. Evaluation of acute and sub chronic toxicity of *Annona muricata* (Linn.) aqueous extract in animals. *European Journal of Experimental Biology*, 1(4), pp: 115-124.
2. Frederico, E. H., Carmo, F. S., Diniz, C. L., Dantas, M. P., Amorim, L. F. and Filho, M. B. **2012**. Influence of an aqueous extract of *Coriandrum sativum* leaves on labeling of blood constituents with technetium-99m and determination of some of its physical parameters. *Journal of Medicinal Plants Research*, 6(44), pp: 5651-5657.
3. WHO (World health organization **2002**. *Traditional Medicine Strategy 2002-2005*. World health organization: Geneva. Accessed on July 2011.

4. Patel, D., Desai, S., Devkar, R. and Ramachandran, A. V. **2012**. Acute and sub chronic toxicological evaluation of hydro-methanolic extract of *Coriandrum sativum* L. seeds. *EXLI Journal*. 11, pp: 566-575.

5. Taylor, J. L. S., Rabe, T., Mc Grow, L. J., Jäger, A. K. and Staden, J. **2001**. Towards the scientific validation of traditional medicinal plants. *Journal of Plant Growth Regulation*, 34(1), pp: 23-37.

6. Patel, D., Desai, S., Devkar, R. V. and Ramachandran, A. V. **2011**. *Coriandrum sativum* L. aqueous extract mitigates high fat diet induced insulin resistance by controlling visceral adiposity in C57B1L6J Mice. *BLACPMA*, 10(2), pp: 127-135.

7. Deepa, B. and Anuradha, C. V. **2011**. Antioxidant potential of *Coriandrum sativum* L. seed extract. *Indian Journal of Experimental Biology*, 49(1), pp: 30-38.

8. Oudah, I. M. and Ali, Y. H. **2010**. Evaluation of aqueous and ethanolic extraction for coriander seed, leaves and stems and studying their antibacterial activity. *Iraq Science Journal of Nursing*, 23(2), pp: 1-7.

9. Reyes, M. R., Reyes-Esparza, J., Angeles, O. T. and Rodriguez-Fragoso, L. **2010**. Mutagenicity and safety evaluation of water extract of *Coriandrum sativum* leaves. *Journal of Food Science*, 75(1), pp: T6-T12.

10. Nambiar, V. S., Daiel, M. and Guin, P. **2010**. Characterization of polyphenols from coriander leaves (*Coriandrum sativum*), red amaranthus (*A. paniculatus*) and green amaranthus (*A. frumentaceus*) using paper chromatography, and their health implications. *Journal Herbal Medicine of Toxicology*, 4(1), pp: 173-177.

11. Wong, P. Y. Y. and Kitts, D. D. **2006**. Studies on the dual antioxidant and antibacterial properties of parsley (*Petreselinum crispum*) and cilantro (*Coriandrum sativum*) extract. *Food Chemistry*, 97(3), pp: 505-515.

12. Ishikawa, T., Kando, K. and Kitajima, J. **2003**. Water-soluble constituents of coriander. *Chemical and Pharmaceutical Bulletin*, 51(1), pp: 32-39.

13. Podalia, R. C., Karki, N., Sah, A. N. and Verma, R. S. **2011**. Volatile constituents of leaf and seed essential oil of *Coriandrum sativum* L. *Journal of Essential oil Bearing Plants*, 14(5), pp: 610-616.

14. Sahib, N. G., Anwar, F., Gilani, A. H., Hamid, A., Saari, N. and Alkharfy, K. M. **2012**. Corainder (*Coriandrum sativum* L.): a potential source of high-value components for functional foods and nutraceuticals-A Review. *Phytotherapy Research*, 27(10), pp: 1-8.Ramadan,

15. M. F. and Morsel, J. T. **2003**. Analysis of glycolipids from black cumin (*Negella sativa* L.), coriander (*Coriandrum sativum* L.) and niger (*Guitoza abyssinca* Gass.) oil seeds. *Food Chemistry*, 80, pp: 197-204.

16. Delaquis, P. J., Stainch, K., Girard, B. and Mazza, G. **2002**. Antimicrobial activity of individual and mixed fractions of dill, cilantro, coriander and eucalyptus essential oils. *International Journal of Food Microbiology*, 74(1-2), pp:101-109.

17. Kansal, L., Sharma, V., Sharma, A., Lodi, S. and Sharma, S. H. **2011**. Protective role of *Coriandrum sativum* (Coriander) extract against lead nitrate induced oxidative stress and tissue damage in liver and kidney in male mice. *IJABPT*, 2(3), pp: 65-83.

18. Naseem, M., Anjum, F. M., Khan, M. I. and Tehseen, S. **2013**. Nutritional and medicinal aspects of coriander (*Coriandrum sativum*). *British Food Journal*, 115(5), pp: 743-755.

19. Mani, V. and Parle, M. **2009**. Memory enhancing activity of Coriandrum sativum in rats. *Pharmacology online*, 2, pp: 827-839.

20. Al-Said, M. S., Al-Khamis, K. I., Islam, M. W., Parmar, N. S., Tariq, M. and Ageel, A. M. **1987**. Post coital antifertility activity of seeds of *Coriandrum sativum* rats. *Journal of Ethnopharmacology*, 21(2), pp: 165-173.

21. Assayed, M. E., Salem, H. A. and Khalaf, A. A. **2008**. Protective effect of garlic extract and vitamin C against cypermethrin reproductive toxicity in male rats. *Research Journal of Veterinary Sciences*, 1(1), pp: 1-15.

22. Kasuga, S., Uda, N., Eyo, E., Ushijima, M., Morihara, N. and Itakura, Y. **2001**. Pharmacologic activity of aged garlic extraction in comparison wirh other garlic preparation. *Journal of Nutrition*, 131(3), pp: 1080s-1084s.

23. World Health Organization (WHO) **2010**. *Laboratory Manual for the Examination and Processing Human Semen*. Fifth Edition. WHO press, 20 Avenue Appia., 1211 Geneva 27, Switzerland.
24. Bancroft, J. and Stevens, A. **1982**. *Theory and Practice of Histological Technique*. Second Edition. Churchill Livingston. Edinburgh and London, pp: 662.
25. Snedecor,G.W.and Cochran,W.G.**1980**.*Statistical Method*, Seventh Edition, Iowa:Iowa state University Press, pp: 215.
26. Kansal, L., Sharma, V., Sharma, A., Lodi, Sh. **2012**. Remedial effect of *Coriandrum sativum* (Coriander) extracts on lead induced oxidative damage in soft tissue of Swiss albino mice. *International Journal of Pharmacy and Pharmaceutical Sciences*, 4(3), pp: 729-736.
27. Alfarah, M. A. Z. **2012**. Toxicity induced histological changes in selected organs of male (Wistar) rats by *Lawsonia merlus* leaf extract. *European Journal of Medicinal Plants*, 2(2), pp: 151-158.
28. Al-Suhaimi, E. **2008**. Effect of *Coriandrum sativum*, a common herbal medicine on endocrine and reproductive organ structure and function. *The Internet Journal of Alternative Medicine*, 7(2), pp:1-7.
29. Shavandi, M. A., Haddadian, Z. and Ismail, M. H. Sh. **2012**. *Eryngium foetidum* L. *Coraindrum sativum* and *Persicaria odorata* L. *A review. Journal of Asian Scientific Research*, 2(8), pp: 410-426.
30. Raji, Y., Akinsomisoy, O. S. and Salman, T. M. **2005**. Antispermatogenic activity of *Morinda lucida* extract in male rats. *Asian Journal of Andrology*, 7(4), pp: 405-410.
31. Sreelatha, S. and Inbavailli, R. **2012**. Antioxidant, antihyperglycemic and antihyperlipidemie effect of *Coriandrum sativum* leaf and stem in Alloxan-induced diabetic rats. *Journal of Food Science*, 77(7), pp: T119-T123.
32. Hammani, I., Nahfi, A., Mauduit, C., Benahmed, M., Amri, M., Benamar, A., Zekri, S., Elmay, A. and Elmay, M. V. **2008**. The inhibitory effects on adult male reproductive functions of crude garlic (*Allium sativum*) feeding. *Asian Journal of Andrology*, 10(4), pp: 593-601.
33. Reddy, C. L., Murthy, D. R. K. and Patil, S. B. **1997**. Antispermatogenic and androgenic activity of various extract of *Hibiscus rosa* Sinensis in albino mice. *Indian Journal of Experiment Biology*, 35(4), pp: 1170-1174.
34. Venkatesh, V., Sharma, J. D. and Kamal, R. **2002**. A comparative study of effect of alcoholic extracts of *Sapindus emarginatus*, *Terminalia belerica*, *Cuminum cyminium* and *Allium cepa* on reproductive organs of male albino rats. *Asian Journal of Experiment Science*, 16(1-2), pp: 51-63.
35. Verma, P. K., Sharma, A., Mathur, A., Sharma, P., Gupta, R. S., Joshi, S. C. and Dixit, V. P. **2002**. Effect of *Sarcostemma acidum* stem extract on spermatogenesis in male albino rats. *Asian Journal of Andrology*, 4(1), pp: 43-47.
36. Mazhar, J. and Mazumder, A. **2013**. Evaluation of antidiabetic activity of methanolic leaf extract of *Coraindrum sativum* in Alloxan induced diabetic rats. *RJPBCS*, 4(3), pp: 500-507.
37. Patil, Sh. J., Satishagouda, S., Vishwanatha, T. and Patil, S. **2010**. Effect of *Terminalia bellirica* barks extracts on activities of accessory reproductive ducts in male rats. *International Journal of Pharmaceutical Sciences Review and Research*, 1(2), pp: 15-79.
38. Lohiya, N. K., Manivannan, B., Nishara, P. K., Pathak, N., Sriram, S., Bhande, S. S. and Panneerdoss, S. **2002**. Chloroform extract of *Carica papaya* seeds induces long-term reversible azoospermia in langur monkey. *Asian Journal of Andrology*, 4(1), pp: 17-26.
39. Thejashwini, M. S., Ram, K. H. and Shivabasavqaih. **2004**. Reversible anti fertility effect of *Cyamposis psoralioides* in male Swiss albino mice. *International Journal of Advanced Biological Research*, 2(4), pp: 657-665.