Effect of Coriandrum sativum, a common herbal medicine, on endocrine and reproductive organ structure and function

E Al –Suhaimi

Citation

E Al –Suhaimi. *Effect of Coriandrum sativum, a common herbal medicine, on endocrine and reproductive organ structure and function*. The Internet Journal of Alternative Medicine. 2008 Volume 7 Number 2.

Abstract

We investigated the effects of Coriandrum sativum seeds, used to treat hyperglycemia and hyperlipidemia, on endocrine functions and structures. Healthy adult male rabbits (n = 20) were randomly divided into two groups: control group and treatment group (250 mg/kg Coriandrum sativum seed aqueous extract). Fasting blood samples were taken in the morning on day 0 (baseline) and day 4 of the 7-day treatment, and day 1 and day 8 post-treatment. Significant changes in cortisol levels occurred during the treatment period, but they could not be attributed to Coriandrum sativum treatment. Testosterone, glucose, and cholesterol were not significantly altered after treatment compared to control or baseline levels. No histopathological changes were observed in the epididymis, pancreas, testis interstitial tissue, or seminiferous tubules. The traditional herbal medicine, Coriandrum sativum, does not appear to exert negative effects on testosterone or cholesterol levels, nor on the reproductive or endocrine functions. The interrelationship between metabolism and gonad functions is an important concern when medicinal plants are used; therefore, use of Coriander sativum requires further study before it can be recommended for use as a medicinal plant.

INTRODUCTION

Spices and herbs are common dietary adjuncts that contribute to the flavor of foods. They are also known to exert beneficial physiological effects (1). Coriandrum sativum, commonly known as coriander or Chinese parsley, has been used as a foodstuff since at least the 10th century (2). Several physiological and medical benefits have been reported for the spice. In Iranian folk medicine, aqueous extract of Coriandrum sativum seed has been recommended for relief of anxiety and insomnia, and may have potential sedative, hypotensive, and muscle relaxant effects (3, 4).

Coriandrum sativum seeds are also used to treat hyperglycemia and hyperlipidemia. Evidence for its efficacy against these conditions has been accumulated in animal models. Coriander has been shown to attenuate the development of streptozotocin–induced diabetes in mice (5). The antihyperglycemic, insulin-releasing, and insulin-like activities for coriander were also demonstrated in mice (6).

Coriander has demonstrated significant hypolipidemic action, and can alter lipid metabolism by decreasing lipid uptake and enhancing lipid breakdown (7). The total cholesterol and triglyceride levels were decreased significantly in the tissues of the animals that received coriander seeds . In addition, a significant decrease in the levels of lipid peroxides, free fatty acids and glutathione was observed when compared to control group, as well as an increase in beta-hydroxy-beta-methylglutaryl-CoA reductase, and plasma lecithin-cholesterol acyltransferase activity (8). Enhanced hepatic bile acid synthesis and the increased degradation of cholesterol to fecal bile acids and neutral sterols appeared to account for coriander's hypocholesterolemic effects (9, 10).

Effects of coriander accumulation in the organs and fertility have been a concern. Earlier feeding studies in rats revealed that petroselinic acid [18:1(n-12)] from triacylglycerols of coriander oil was extensively incorporated into the lipids of heart and liver (11). The effect of the aqueous extract of fresh coriander seeds was studied on female fertility by administration in rats on different days of the pregnancy. Coriander extract at oral doses of 250 and 500 mg/kg produced a dose-dependent anti-implantation effect, but failed to produce complete infertility. There was no significant change in the weight and length of fetuses delivered by rats treated with the extract, and no

abnormalities were seen in the organs of the offspring (12).

The aim of this work was to determine if Coriandrum sativum seeds have any negative effects on some endocrine and reproductive functions in adult male healthy rabbits.

MATERIAL AND METHODS

Twenty male rabbits (6–9 months old; 1.3–2.7 kg) were housed in laboratory cages for this experiment. After a 5-day adaptation to the environment, treatment was initiated. Rabbits were given ad libitum access to food and water.

Rabbits were randomly divided into two groups: a control group (n = 10) and a group treated with aqueous extract of Coriandrum sativum seeds (250 mg/kg body weight; n = 10) as previously described (12). Blood samples were collected by ear vein puncture in the morning after overnight fasting at the following timepoints: day 0 before initiation of the 7-day treatment (baseline),day 4 of treatment, day 1 day 8 post-treatment. Sera were separated immediately and stored at-18°C for subsequent analysis. Serum cortisol and testosterone concentrations were determined using the enzyme immunoassay kit (Roche Diagnostics GmbH, D. Mannheim Germany)on the Architect i2000 analyzer. Serum cholesterol and glucose concentrations were determined using Reflotron packages (Roche Diagnostics GmbH, D. Mannheim Germany) on the Reflotron system. The animals were sacrificed eight days after treatment ended (day 8 post-treatment). The testes, epididymis, and pancreas were removed and fixed in 10% formalin for preparation of hematoxylin and eosin stained histological sections. Digital images were captured with a Leica DME camera and a Leica DFC 280 compound microscope.

STATISTICAL ANALYSIS

Biochemical results were analyzed using one-way analysis of variance (ANOVA) followed by the least significant difference (LSD) post-hoc test for multiple comparisons. Pearson correlation coefficients were calculated for the investigated parameters. Data are presented as mean ± SE. Statistical significance was set at $P < 0.05$. Calculations were performed using SPSS software ver. (12).

RESULTS AND DISCUSSION

Most of treated animals did not demonstrate significant histopathological alterations in the examined tissues. The testes in animals of both treatment groups were active and revealed the various stages of spermatogenesis (Fig. 1, 3). Figure (2) shows the normal structure of interstitial tissue (Leydig cells) observed in the control group. In treated animals, fat vacuoles were not apparent in the interstitial tissue, which indicated that these testosterone-secreting cells were active (Fig. 4). Similarly, the epididymis lumen was normal and contained large numbers of mature sperm in both groups (Figs. 5, 6). The pancreas of coriander-treated animals displayed normal acinar shape with prominent pancreatic islets (Fig. 7), similar to results from a study of coriander's effects on blood glucose in normal and streptozotocin-induced diabetic mice (5).

Serum biochemical analysis did not reveal any significant differences between the control and treatment groups, with the exception of cortisol levels (Table 1). We believe this is the first study investigating the effects of coriander on cortisol hormone levels. Cortisol levels at day 4 of coriander treatment were significantly elevated compared to levels at baseline and on days 1 and 8 post-treatment; however, they were not significantly different compared to untreated animals. The high cortisol levels at day 4 decreased gradually in both groups and no significant differences were observed between the treated group and the control group at any time point during the experiment. The higher cortisol level both groups at day 4 may be a reaction to stress factors (blood sampling and fasting), known as the "general adaptation syndrome"(13, 14).

Fasting glucose levels did not differ significantly between the treatment groups, but a nonsignificant decrease in glucose levels was seen after 4 days of coriander extract treatment. The treatment group exhibited the lowest levels of both glucose and cortisol on day 1 post-treatment. Cortisol is known to have hyperglycemic effects (13); however, glucose levels did not rise above baseline, perhaps due to the glucose-lowering effects of coriander. This finding was similar to other studies (1, 6), in which coriander incorporated into the diet (62.5 g/kg) and drinking water (2.5 g/l, prepared by 15 min decoction) in streptozotocin-diabetic mice was reported to have hypoglycemic properties. The lack of glucose-lowering effects of coriander extract in this study may also be due to the use of nondiabetic rabbits. In another study, 12 days of coriander treatment did not alter plasma glucose and insulin concentrations in normal mice, but reduced the level of hyperglycemia in streptozotocin-induced diabetes (5).

Cholesterol levels were below 100 mg/dl in both groups (minimum limit of the used kit was 100 mg/dl) throughout the course of the experiment. In our study, coriander seed

extract did not affect cholesterol level, in contrast with a previous study that reported that levels of LDL and VLDL cholesterol decreased while HDL cholesterol increased after coriander treatment (6). Unlike the current study, previous studies examining the effects of coriander in animal models of hypercholesterolemia observed cholesterol-lowering effects. For example, coriander was found to play a protective role against the deleterious effects of lipid metabolism in colon cancer in a rabbit model of Triton-induced hyperlipidemia (15). Another study found that Coriandrum sativum (1 g/kg body weight) reduced cholesterol and triglyceride synthesis and secretion in triton-induced hyperlipidemic rats. (7). In addition, lack of a cholesterol-lowering effect in this study may be also due to the low dose (250 mg/kg) used in present study.

We observed low baseline testosterone levels in the rabbits, similar to low levels recorded in another study in adult male rabbits (16). Testosterone levels did not differ significantly between groups throughout the study. Results of the histological assessment of testis and epididymis were also similar between groups (Figs. 5, 6). no studies investigating the effects of coriander on androgens have been conducted in any animal models or in humans. However, aqueous extract of fresh coriander seeds produced a significant decrease in serum progesterone levels in female rats on day 5 of pregnancy, which may be responsible for the observed anti-implantation effect (12).

The Pearson correlation test revealed – in treatment group - a significant positive correlation between glucose and testosterone at baseline and on day 8 post-treatment ($P < 0.05$ and $P < 0.01$, respectively). A highly significant negative correlation between cortisol and testosterone and highly significant positive correlation between glucose and cortisol were observed post-treatment ($P < 0.01$).

We conclude that the use of coriander seed aqueous extract as described has not negative effects on studied parameters and organs. Correlation between metabolism and gonads functions must be taken in consideration when medical plants were used. However, further studies are needed to test the effects of coriander on other vital organs.

Figure 1

Table (1): Effect of seed extract on glucose, cholesterol, cortisol, and testosterone in adult male rabbits

		Glucose (mg/dl)	Cholesterol (mg/dl)	Cortisol (µg/dl)	Testosterone (ng/ml)
Day 0 (before treatment)	Baseline	152.60 ±20.33	<100	2.14 [b] ±0.24	0.58 ±0.14
Day 4 of treatment	Control group	131.25 ±8.22	<100	2.46 [c] ±1.07	1.84 ±1.48
	Treatment group	141.50 ±7.14	<100	2.91 [a] ±0.63	0.89 ±0.26
Day 1 post-treatment	Control group	136.25 ±9.06	<100	1.82 ±0.73	1.92 ±1.28
	Treatment group	128.00 ±5.59	<100	1.00 [a,b,c] ±0.29	0.81 ±0.20
Day 8 post-treatmentTreatment	Control group	130.75 ±2.21	<100	1.10 [a,b] ±0.12	0.63 ±0.31
	Treatment group	150.50 ±8.34	<100	1.24 [a] ±0.32	0.70 ±0.33

Data indicates mean ± SE

Values with the same letter superscript are significantly different ($P < 0.05$).

Figure 2

Figure 1. The normal structure of seminiferous tubules at various stages of spermatogenesis (control). H and E X 40

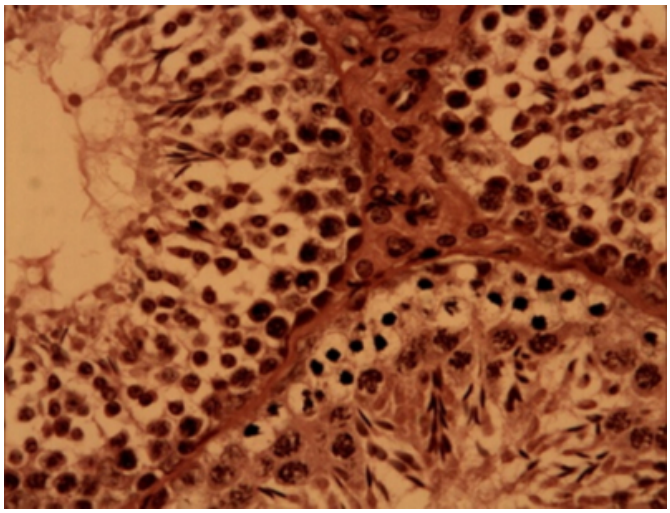


Figure 3

Figure 2. The normal structure of interstitial tissue (Leydig cells) between seminiferous tubules (control). H and E X 100

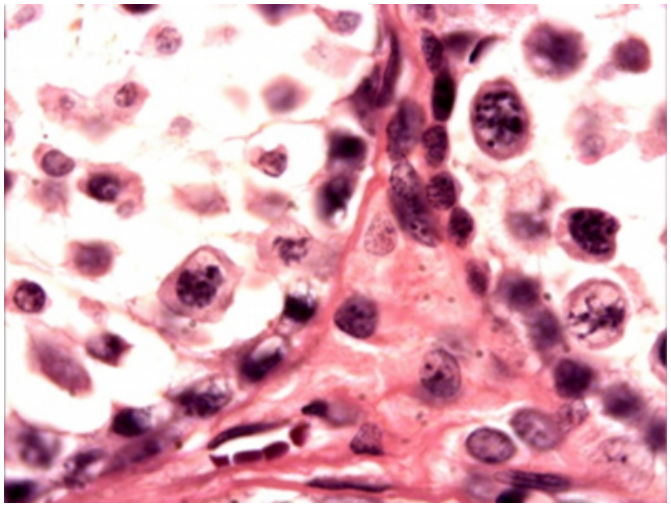


Figure 4

Figure 3. Coriander treatment did not alter the normal structure of seminiferous tubules, shown at various stages of spermatogenesis (day 8 post-treatment). H and E X 40

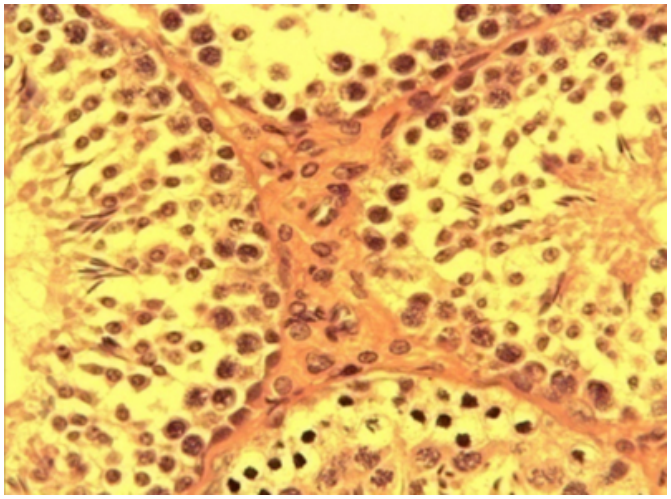


Figure 5

Figure 4. Coriander treatment did not alter the normal structure of interstitial tissue between seminiferous tubules (treatment group; day 8 post-treatment). Leydig cells appeared without fat vacuoles, which indicate that these testosterone-secreting cells were active. H and E X 100

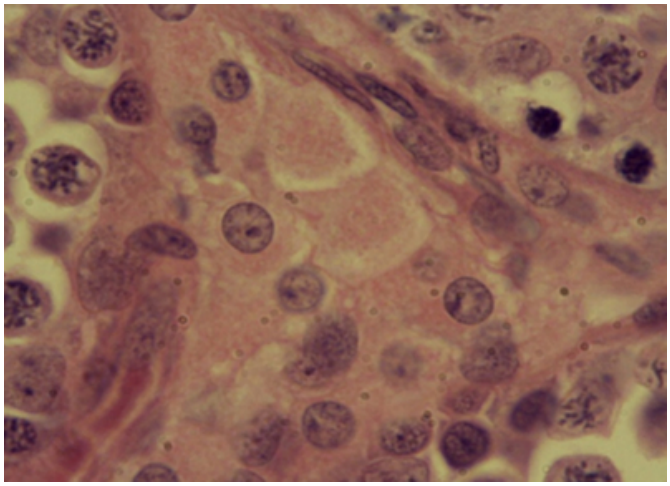


Figure 6

Figure 5. The normal epididymis structure showing tubules filled with mature sperm (control group). H and E X 40

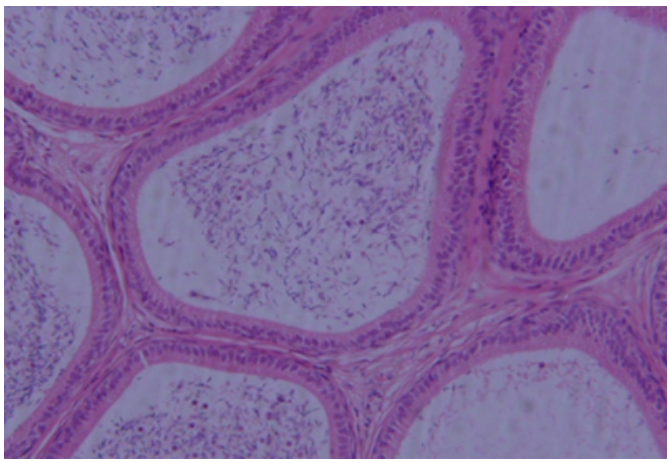


Figure 7

Figure 6. Coriander treatment did not alter the normal structure of the epididymis. Most tubules were filled with mature sperm (treatment group; day 8 post-treatment). H and E X 40

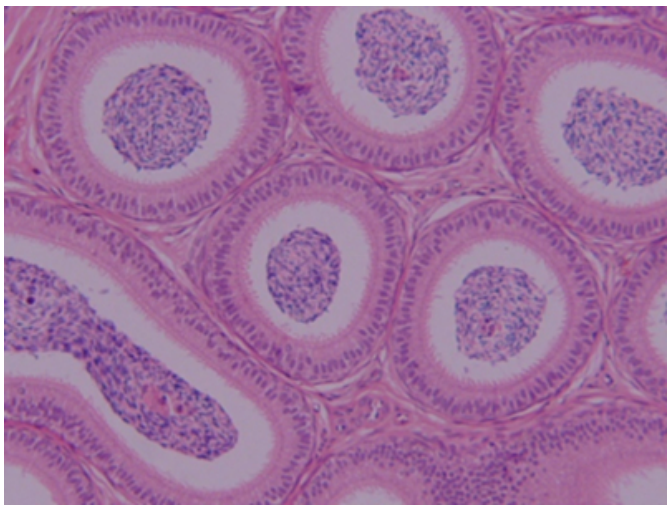
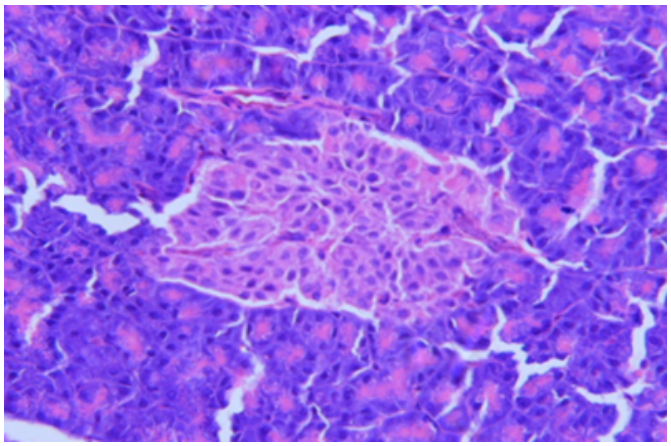


Figure 8

Figure 7. Coriander treatment did not alter the normal structure of pancreatic islets of Langerhans (treatment group; day 8 post-treatment). H and E X 10



ACKNOWLEDGEMENTS

Thanks are due to Haya Al-Boaijan for her great help and to the Dean of Medicine and Medical Sciences at KFU, Dr. Al-Rubish for use of animal facilities. We thank Al-Groni Badar for his technical assistance.

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Author Information

Ebtesam A. Al –Suhaimi
Zoology Department (Physiology), Science College for Girls, King Faisal University, Dammam, KSA