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Morphological and Morphmetric Studies on Embryo Development in Camphor Treated Pregnant Rats

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Abstract. Camphor has long been used in dead bodies wash in Saudi Arabia. Experiments were conducted to study the effect of camphor on Sprague–Dawley rats and embryos. Pregnant rats (n = 36) were divided into 4 groups (n = 9); 3 groups were given intraperitoneal injection by different doses of water camphor solution (5, 10 and 20 mg camphor/kg body weight); control group was given the same doses of distilled water. All groups were kept in constant room temperature (22° ± 2°C), and in a 12 h light/12 h dark photoperiod. At the end of 1st, 2nd and the 3rd week of gestation, 3 animals from each group were anesthetized; their plasma and embryos were removed. The results obtained showed a significant increase in body weight of pregnant rats in week 1 of gestation for G2 (10 mg/kg), and in week 2 of gestation for G3 (20 mg/kg) compared to control. The hormonal analysis did not show significant differences with all used doses. However, a significant decrease in fetal body length and weight were recorded, increase in number of dead and incomplete growth embryos in G3 (20 mg/kg) were observed. The present study shows that camphor effects on rats embryos. Therefore, caution is recommended in its use, especially for pregnant women

Keywords: Camphor, Pregnant rats, Embryos.

Introduction

Camphor is a white crystalline substance, obtained from the tree *Cinnamomum camphora*, commonly known as Camphor tree, Camphor

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wood or Camphor laurel. It has been used for many centuries as a culinary spice, a component of incense, a bug-repellant and a flea-killing substance, as well as in medicine[1].

Nowadays, camphor is synthetically produced from turpentine oil and is present in many non-prescription medicines such as Tiger Balm, Vick's Vaposteam, Bayer Muscle and Joint Cream, plus many other medicines[2]. Camphor oil contains many compounds such as camphor, safrol, eugenol, terpeniol, cineol and ligans[1].

Although camphor is a natural substance, it was known by the Asian nations since ancient times. Its synthetic form is now available and being produced for medical, sanitary, and industrial usages[3,4]. As it is believed by the ancient's people, camphor is used not only as an aromatic material, but also for different purposes, such as stimulation of circulatory and respiratory systems, psychological stimulation, and cosmetics (as sun protection) for external use[5]. In addition, due to an olden belief, camphor can be used for modulating sexual activity, contraception, inducing abortion, and reducing milk production in lactating women[6,7].

Accordingly, camphor may affect sexual activity, and although not documented, studies in different parts of the world are in agreement with this belief[5]. Administration of 100 mg/kg of camphor to mice, which have been under gamma rays, has modulated spermatogenesis in their tests[6].

Camphor derived oxidant substances that have been traced in umbilical cord, blood, and fetal tissues (including brain, liver and kidneys). It has been shown that camphor can easily pass through placental barrier and affect development[8]. Most severe cases are associated with the ingestion of camphorated oil, either deliberately or in mistake for other medication, *e.g.*, castor oil[9].

In Saudi Arabia, camphor in the form of tablets was added to wash dead bodies, and thus, putting washers in great risk, especially pregnant female washers. Though, literature concerning its reproductive toxicity is not documented.

Thus, the main objective of this study is to evaluate the effect of camphor on pregnant rats and embryos.

Materials and Methods

Camphor

Camphor tablets (Deer Brand, Rec. Trade mark, Made in China) were obtained from the traditional medicine market such as the natural herbs and spices shop in Hail Street, Jeddah, KSA.

Animal Husbandry and Camphor Administration

Adult male (body weight, 150—200 g) and virgin female (body weight, 120 – 150 g) of Sprague-Dawley rats were obtained from the Animal House at King Fahad Medical Research Centre, and maintained in constant temperature control rooms (22° ± 2°C). Animals received food and water on a 12 h light/12 h dark photoperiod. After one week of acclimatization, untreated females and males mated by overnight cohabitation (one male to three females). The following morning, females were examined for the presence of a vaginal plug and vaginal smear by a method described by Taylor[10]. Samples for making a vaginal smear can be collected by inserted a cotton tipped swab moistened with phosphate buffered saline into the vaginal cavity of a rat. The swab should be applied gently against the vaginal wall and rolled slightly before withdrawing. The moist swab is then rolled onto a clean glass microscope slide. The specimen is spray fixed using 95% ethanol. Pregnancy was confirmed by the presence of vaginal plugs; this was considered as gestational day zero (GD0)[11], the vaginal smear showed white blood cells and spermatozoa. All rats and embryos in this experiment were weighed before the first injection, and at the end of 1st, 2nd and 3rd weeks of gestation.

The present study was conducted to investigate the effect of camphor on the pregnant rats and embryos. The pregnant females were divided into four groups; each group consisted of 9 pregnant females. Pregnant females of the three experimental groups received intra-peritoneal injections of camphor solution dissolved in distilled water. The dose has been chosen from a study by Jamshidzadwh and Sajedianfard[12] (they were studying the effect of camphor three doses on the male rat ; 5, 10 and 20 mg camphor/kg body weight / 5 days / week, respectively), and control group (9 rats) were injected by the same volume of distilled water.

At the end of 1st, 2nd and 3rd week of gestation, three animals from each group were anesthetized by using chloroform. Their uteri were removed and placed on clean paper to counting embryos in each uterine horn and made a lateral longitudinal cut in each horn to remove the embryos for the morphological examination. Blood samples also were obtained to prepare plasma for the physiological studies, as described afterward.

Morphological Examination

Embryos were studied in experimental and control groups at the age of 21 days of pregnancy, as embryos were completely developed and ready for delivery. They were examined morphologically, weighted and photographed by using a Nikon digital camera (Cool Pixs 10 Digital Camera). The embryos were placed next to a ruler for measuring the length of the fetus.

Morphometric Studies

Measurements were taken by a computer program called UTHSCA Image tool, which was used to measure the fetus body length, the greatest dimension of the fetus head, and then this information was entered in Excel 2007 for analysis by the statistics program SSPS 16 (Fig 1).

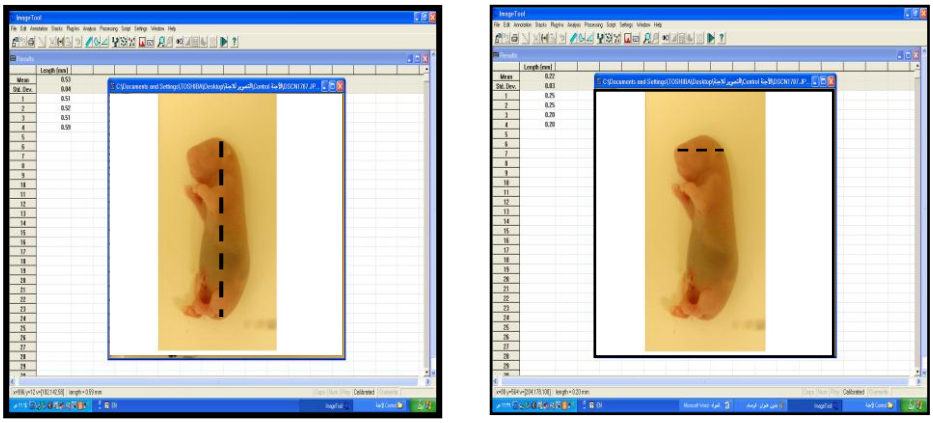

Fig. 1. Shows how to measure the length and the head greatest dimension of the fetus on the age of 21 days.

Hormonal Assays

Animals were slightly anaesthetized and their eyes bled within two minutes by using a heparinized syringe, and blood samples were taken

from each rat by the end of 1st, 2nd and 3rd weeks of gestation. The blood samples (10 ml from all rats) were collected in EDTA tubes, and then centrifuged at 1200 rpm for 10 minutes to separate the plasma from the blood cells and were kept at -20 °C. Hormonal assay for estrogen and progesterone serum levels was done using (Estradiol-E2, Elecsys and cobase analyzers, Roche Diagnostic Gmbh.D-68298 Mannheim: US Distributor), (Progesterone 12145383122, Elecys 1010/2010 and MODULAR ANALYTICA E170, Roche Diagnostic Gmbh.D-68298 Mannheim: US Distributor).

Statistical Analysis

The pregnant rat's whole body weight and embryos weight measurements were analyzed. Also estrogen and progesterone concentration data were compared at appropriate confidence intervals. Values were recorded as mean + S.E.M. and all data were statistically analyzed using SPSS 16. The normality test was done using one way ANOVA, Test of Homogeneity of Variances. Student-Newman-Keuls test and Tukey test were performed to see if there were any significant differences between the treated and the control groups. In all cases, the difference was considered significant if $p \leq 0.05$.

Results

During the experiment, all animals survived and this means that the doses administered were appropriate. Morphological examinations for treated and control groups did not show any changes on the pregnant female's external shape. Some embryos showed congenital malformations, which suggest a toxicity effect of camphor on the exposed animals.

Effects of Camphor on Body Weight of Pregnant Rats

In week 1 of gestation, a significant increase was noticed in the body weight of pregnant rats in G2 (10 mg/kg) ($p = 0.002$) compared to the control (Fig. 2a). Also, week 2 of gestation showed a significant increase in the body weight in G3 (20 mg/kg) ($p = 0.019$) compared to the control (Fig. 2a). While week 3 of gestation showed a decrease in the body weight in G1 (5 mg/kg) ($p = 0.478$) and G2 (10 mg/kg) ($p = 0.997$), increase in G3 (20 mg/kg) ($p = 0.977$) compared to controls, but the differences were not significant (Fig. 2a).

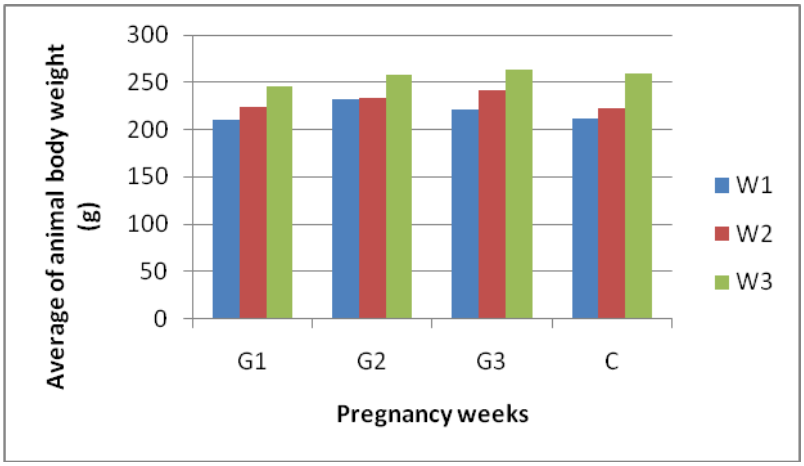

Fig. 2a. Shows effect of camphor on body weight of pregnant rats.

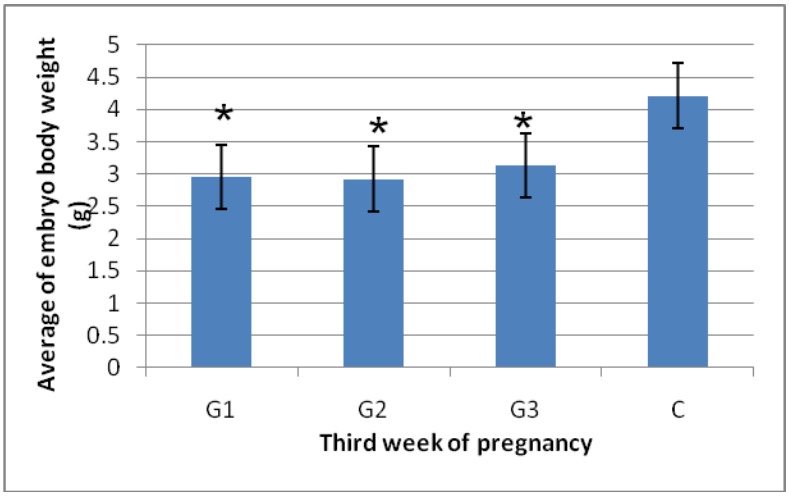

Fig. 2b. Shows effect of camphor on the rat embryo whole body weight.

Effect of Camphor on the Rat Embryo Whole Body Weight

Embryos of all treated groups showed a significant decrease in the whole body weight; G1 (5 mg/kg) ($p = 0$), G2 (10 mg/kg) ($p = 0$), G3 (20 mg/kg) ($p = 0.001$), compared to control (Fig. 2b).

Effect of Camphor on the Rat Embryo Whole Body Length

The results show a significant decrease in the embryos length with all doses, G1 (5 mg/kg) ($p = 0.002$), G2 (10 mg/kg) ($p = 0.001$), G3 (20

mg/kg) (p = 0.001) compared to control. The decrease in the embryos' length was dose dependent increase (Fig. 3).

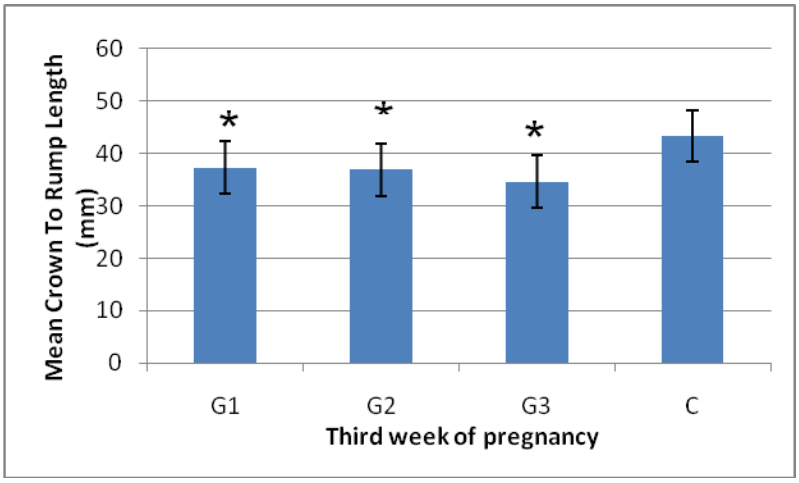

Fig 3. Shows effect of camphor on the rat embryo whole body length.

Effect of Camphor on the Head Circumference of Rat Embryo

The results show a significant decrease in embryos head circumference of experimental groups; G1 (5 mg/kg) (p = 0.001), G2 (10 mg/kg) (p = 0.001), G3 (20 mg/kg) (p = 0.001), compared to control (Fig. 4).

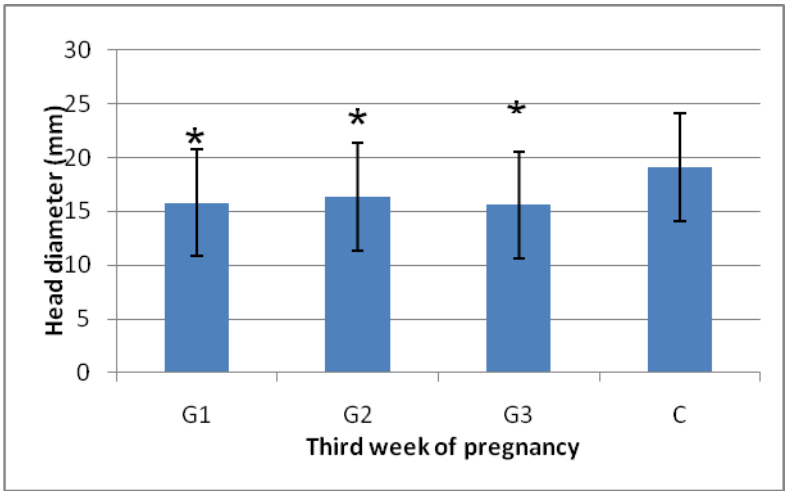

Fig. 4. Shows effect of camphor on the head circumference of rat embryo.

Morphological Studies for Uterus and Embryos (21- days old)

The study showed normal control uteri without atrophy or contraction. The embryo was alive, growth complete, normal shape and size characteristic of the 21 days old, with a bright red color. The embryos' head has a clear ear, eye and mouth. The trunk has complete limbs with five fingers in each and a clear tail (Fig. 5A).

The experimental groups showed that injecting pregnant rats with camphor different doses for three weeks induced toxic effects on fetuses, possibly due to the toxicity of active compounds in camphor.

A- Results of G1 (5mg/kg) treatment compared to control. It was observed atrophy in part of the uterus (arrow) with outside distorting retarded dead fetus. In comparison with the control group fetus, it was taking yellowish-white color with very small size of the fetus (Fig. 5B).

The embryo seemed to be at the age of 9 dpc (range 8.5-9.75) which, showed the rostral extremity of the neural tube closes in embryos with usually about 15-18 somite pairs and defines this stage. The optic pit becomes progressively more indented but not closed; the mandibular process of the 1st branchial arch is clearly visible. The 3rd branchial arch becomes visible later in the stage. An increasingly prominent ridge on the lateral body wall, approximately at the level of the 8th to 12th somite, indicates the site of the future forelimb bud, all abnormal embryos were taken yellowish-white color compared to control (Fig. 5B). When compared normal embryos in G1 (5 mg/kg) with control group embryos were found to be smaller in size (Fig. 6A).

Results of G2 (10 mg/kg) embryos compared to control group (Fig. 5C), the arrow showed uterus shrinkage and atrophy; in this region a dead embryo was found with degenerative changes, distortions and growth retardation. The white color embryo had stopped developing at age of 9 dpc (range 8.5-9.75), it was very small size compared to control. When compared live embryos in G2 (10 mg/kg) with control group embryos were found to be smaller in size (Fig.6B).

When compared high-dose, G3 (20 mg/kg) embryos with G1 (5 mg/kg), G2 (10 mg/kg) and control group embryos, the results showed an increase number of distorted dead embryos (Fig. 5D). Showed two areas of the uterus, (1) had dark red color dead embryo compared to bright red

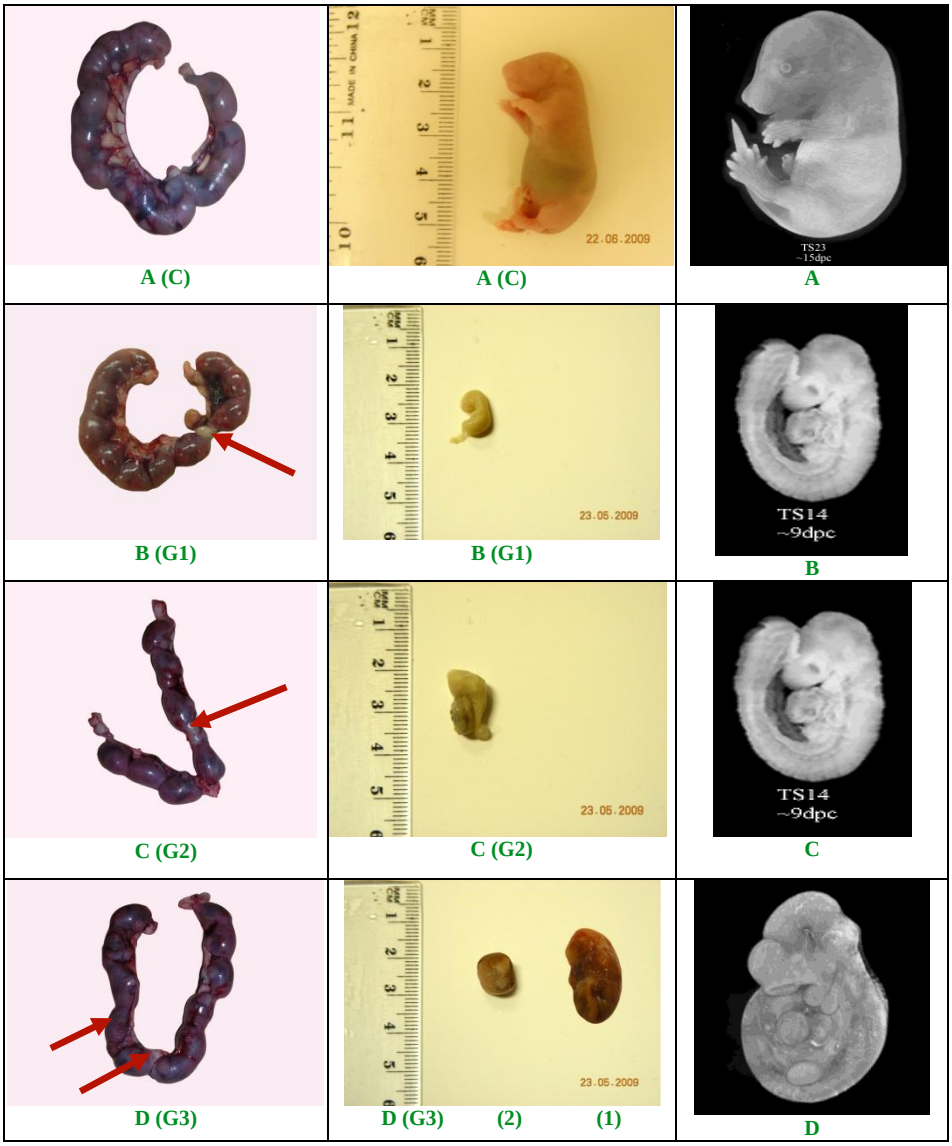

Fig. 5. ***A*** **shows normal uterus with bright red color control embryo compared to normal embryo at age 21 old days.** ***B*** **shows G1 (5 mg/kg) atrophy uterus with outside small dead embryo compared to (9 dpc) embryo.** ***C*** **shows G2 (10 mg/kg), the arrow showed shrinkage uterus and a dead embryo with distortions and growth retardation compared to (9 dpc) embryo.** ***D*** **shows G3 (20 mg/kg), the arrows showed two areas of the uterus, (1) had dark red color dead embryo (2) showed the placenta with stuck incomplete embryo compared to (10 dpc) embryo. http://php.med.unsw.edu.au/embryology**

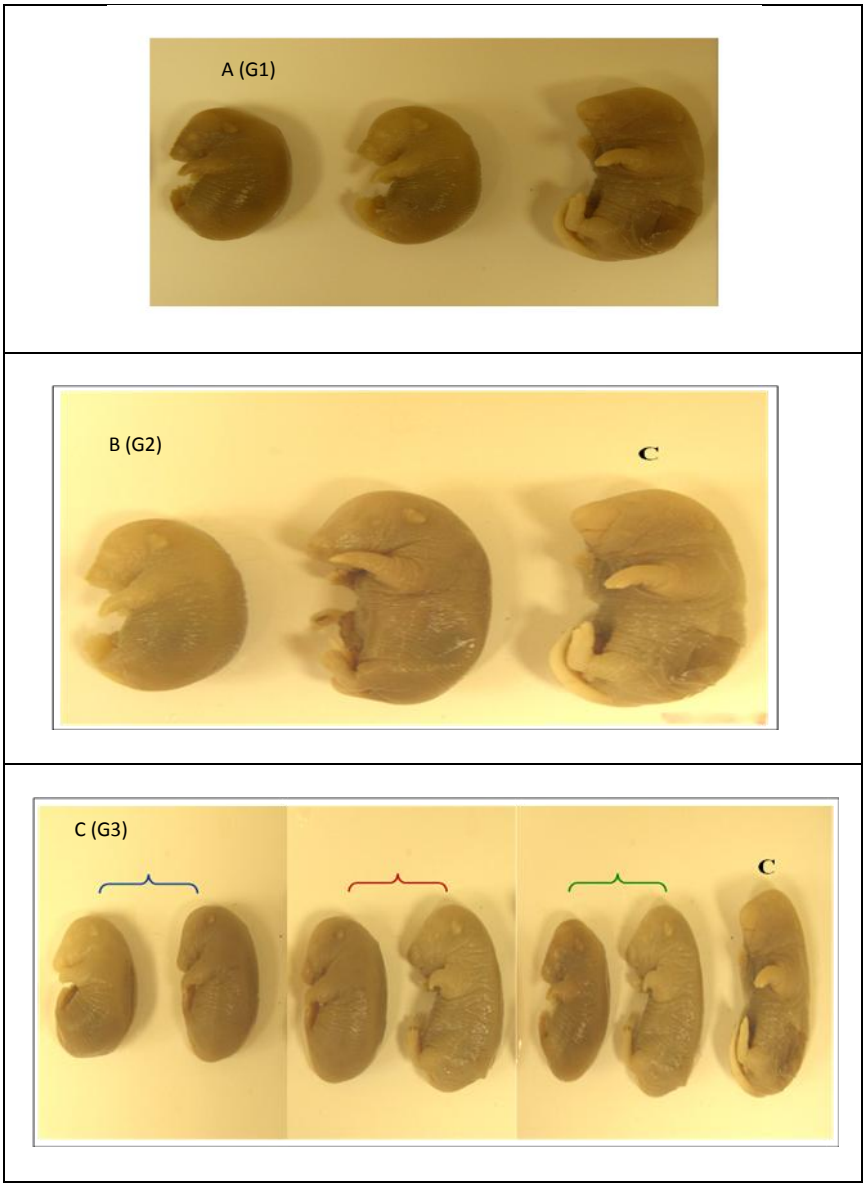

Fig. 6. A showed the difference in size of G1 (2) embryos compared to control group embryo. B showed the difference in size of G2 (1) embryos compared to control group embryo. C showed the difference in size of G3 (1) (green), G3 (2) (red), G3 (3) (blue) embryos compared to control group embryo.

color embryo at the age of 21 day. It was smaller in size with facial and trunk distortion, abnormal limbs and Hypoplasia. The embryo had viscous body, which seemed to stop developing at the age of 10 dpc (range 9.5-10.75); at this age the hind limb bud becomes visible at the level of the 23rd-28th somites. The tail bud appears as a short stump and the 3rd and 4th branchial arches are distinctly concave, Rathke's pouch and the nasal processes start to form. At the end of this stage the posterior neuropore begins to close. The other area of the uterus (2) showed the placenta with stuck incomplete embryo (Fig. 5D). When compared G3 (20 mg/kg) living embryos with control group embryos, they were found smaller in the size and one embryo had a dark red color (Fig. 6C).

Study results showed that the total number of embryos in the experimental groups is less than the control group. When compared the total number of dead embryos, it was found increased in G3 (20 mg/kg) than G1 (5 mg/kg), G2 (10 mg/kg) and control group Table 1.

Table 1. Shows the total of embryos in experimental groups and control group.

Doses	G1 (5 mg/kg)	G2 (10 mg/kg)	G3 (20 mg/kg)	Control (0 mg/kg)
Number of pregnant rats (3 week gestation)	3	3	3	3
Total number of embryos	31	29	34	35
Living embryos, %	28 (90%)	26 (89.7%)	27 (79.4%)	35 (100%)
Normal embryos, %	26 (83.9%)	23 (79.3%)	21(61.7%)	35 (100%)
Number of dead embryos, %	3 (9.7%)	3 (10.3%)	7 (20.5%)	0

Effects of Camphor on Estrogen Level

This study showed a non significant decrease in the estrogen level compared to the control in all treated groups, G1 (5mg/kg) ($p = 0.917$), G2 (10mg/kg) ($p = 0.531$) and G3 (20mg/kg) ($p = 0.245$) at the end of week 1 of gestation; week 2 of gestation G1 (5 mg/kg) ($p = 0.898$), G2 (10 mg/kg) ($p = 0.866$) and G3 (20 mg/kg) ($p = 0.807$), and week 3 of gestation, G1 (5 mg/kg) ($p = 1$), G2 (10 mg/kg) ($p = 0.990$) and G3 (20 mg/kg) ($p = 0.926$) compared to control groups (Fig. 7). Although, Camphor caused dose dependent decrease in estrogen level, the differences were not significant during gestation weeks.

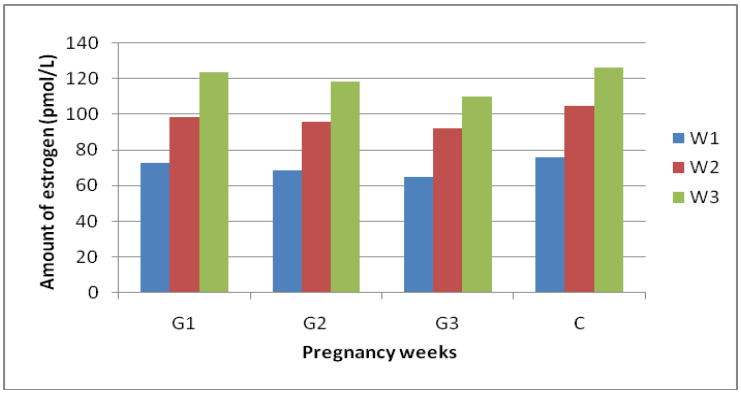

Fig.7. Showed effect of camphor on estrogen levels.

Effect of Camphor on Progesterone Level

It was noticed that the progesterone level at the end of week 1 of gestation decreased in all treated groups, G1 (5 mg/kg) ($p = 0.506$), G2 (10 mg/kg) ($p = 0.427$) and G3 (20 mg/kg) ($p = 0.245$); in week 2 of gestation, G1 (5 mg/kg) ($p = 0.969$), G2 (10 mg/kg) ($p = 0.955$) and G3 (20 mg/kg) ($p = 0.920$), and week 3 of gestation, G1 (5 mg/kg) ($p = 0.929$), G2 (10 mg/kg) ($p = 0.887$) and G3 (20 mg/kg) ($p = 0.866$) but it was not significant decrease compared to controls (Fig. 8). Although, it was noticed that the progesterone and estrogen levels were decreased gradually in all treated groups during the 3rd weeks of gestation compared to control groups; the differences were not significant, which suggest that camphor did not have a significant impact on the level of progesterone and estrogen hormones in all treated groups during pregnancy period.

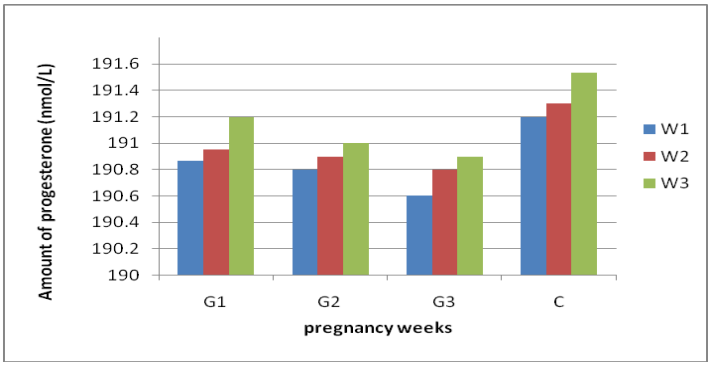

Fig.8. Shows the effect of camphor on progesterone levels.

Discussion

Camphor is used nowadays as an active ingredient in many substances such as cosmetics, especially creams protecting from UV[13], medicines, rubs for muscles and colds[14]. It is also used as mouth repellent and an artificial flavoring to give acceptable odor to insecticide[13].

The results of this study found that, the injection of pregnant rats with camphor water solution doses (5, 10 and 20 mg/kg) for five days caused an increase in rats body weight of G2 and G3 compared to control, and the increase was significant in G2, which agreed with a study by Tinwell *et al.*[15], where immature female rats were subcutaneously or orally injected by 500 – 800 mg/kg 4- Methylbenylidine Camphor (4MBC). Both groups had significantly increased whole body weight compared to the controls. On the other hand, these result did not agree with a study conducted by Leuschner[16] on D-Camphor (CAS 76-22-2), when given different doses (up to 1000 mg/kg / day) by mouth to pregnant rats, where noted lack of movement and a decrease in body weight, especially with high doses, as well[12]. Jamshidzadeh and Sajedianfard[12] demonstrated a body weight decrease for all treated rats by different camphor doses. In contrast, Soucy *et al.*[17] had shown that feeding pregnant rats by different doses (4 or 40 mg/kg) of Genistein, which had hormonal estrogenic activity and the main component of soy, did not affect the body weight.

In pregnant rats injected for two weeks, it was noticed a significant increase in body weight for G3 (20 mg/kg), which agrees with the study by Leuschner[16], where Leuschner observed increasing weight by the higher dose on pregnant rabbits, when given camphor doses with food (up to 681 mg/kg/day). Also, it was noticed that there was no significant differences in body weight of pregnant rats injected for three weeks in all treated groups, compared to control. This was probably due to the injection of the length period which caused body adaptability with the camphor substance.

The current study showed that exposure of pregnant rats to different doses of camphor solution during pregnancy, resulted in small size embryos at age (21 days) with significant difference in the total length of embryos, plus the head circumference in the experimental groups compared to control group. In addition, embryos weight in treated groups

was lower than the control group embryos. This clearly indicated that camphor had negative effects on the development and fetal growth, as it caused retarded growth and incomplete distorted embryos which may lead to fetal deaths. This may perhaps be due to antibiotic activity of camphor[18].

The morphological results showed presence of congestion in the uterus horns, especially with high-dose (20 mg kg), embryos atrophy and less embryos number as a result of loosing during the three gestation weeks compared to control. This may be due to the toxicity of camphor active compounds when crossing the placenta, which represented the tissue damage and caused fetus death inside the uterus. This result agreed with Yoshimura *et al.*[19] study, which stated less normal embryos number when injected by Shiga Toxin 2 (Stx2) in the early stage of pregnancy (5 days), and does not agree with Leuschner[16] studies, where camphor did not affect the embryos number in pregnant rabbits.

The results of small size embryos in experimental groups compared to embryos control group have agreed with Chan *et al.*[20] study, where it was noticed the differences in the embryos body length with abnormalities development in limb, eye and heart, when given pregnant rats Sprague-Dawley 50 mg/kg of extract ginseng (compared camphor with ginseng extract because its plant extract like camphor).

It was also noticed in the current study, that dead and distorted embryos in experimental groups had a yellowish white color. This may be explained as the embryos did not get enough blood supply and therefore could not grow, also one dark red color embryo was observed and was believed it had a bleeding and blood clots.

Estrogen was excreted by placenta during pregnancy to increase the movement of uterus tubes and periodic effects on uterus, cervix and vagina. It increases blood flow in the uterus and the amount of contractive muscle tissue. Estrogen assists in development of female sexual characteristics and mammary glands growth. It also effects smooth muscle contraction in the uterus wall in response to prostaglandin hormone[21].

The current study showed no significant differences in estrogen level, when comparing treated groups with control group. However, results showed an increased estrogen level with the gestational progress in control groups, which confirmed what was stated in the study by Wei *et*

al.[22], indicating that the level of estrogen increases during pregnancy. In contrast, G1 (5 mg/kg), G2 (10 mg/kg) and G3 (20 mg/kg) showed a significantly gradually decreasing estrogen level each week during pregnancy, indicating that the camphor had a dose dependent effect on hormone levels; as estrogen level decreases by increasing the dosage of treatment. This decrease was clear in higher doses (20 mg/kg), but this decreasing in estrogen levels was not significant compared to control group.

Furthermore, progesterone hormone is excreted by the placenta to influence the cyclical changes that occur in the endometrium before pregnancy; prepared it to receive and implant fertilized eggs, and works on the stability of pregnancy. Progesterone reduces the respond to the Oxytocin hormone and reduces estrogen receptors in endometrium. It stimulates the growth of breast glandular and prevent stimulating prolactin hormone for lactation during pregnancy, whereas high concentration of progesterone in the presence of estrogen inhibits the secretion of nerve cells to the hormone[23-24].

Progesterone secretion prepares the uterus for fetus implantation. Endometrium had increased in thickness under the influence of estrogen as well as uterus glands. Fetus implantation in the uterine wall does not happen without the effect of hormone progesterone, as it's called pregnancy hormone, which is essential for pregnancy[22]. Progesterone hormone helps to prevent uterus muscle contraction and maintains pregnancy[21,25].

The current study showed that progesterone level in the control group almost invariably did not change during pregnancy[26], with increasing gestational age from the first week to the third week gestation at the same value. When comparing the level of progesterone in the control group with different treated groups, it was found that hormone levels were decreasing during pregnancy by increasing the dosage and the period of treatment, but also, not significant compared to control. Results indicated that camphor had no effect on progesterone and estrogen levels in this study.

Conclusion

The results obtained show the effect of camphor on the body weight of pregnant rats and fetal body length and weight, while it did not have a

significant impact on the level of progesterone and estrogen hormones in all treated groups during pregnancy period. Results also show the camphor negative effects on rat's embryos development. Therefore, caution is recommended in its use, especially for pregnant women.

References

[1] **Oodi J.** The New Plant and Aromatic Pharmacopeias, 1st ed. Lebanon, 2004. 50-55.

[2] **Ashby J, Tinwell H, Odum J, Lefevre P.** Natural variability and the influence of concurrent control values on the detection and interpretation of low-dose or weak endocrine toxicities. *Environ Health Perspect* 2004; **112**(8): 847-853.

[3] **Anczewski W, Dodziuk H, Ejchart A.** Manifestation of chiral recognition of camphor enantiomers by alpha-cyclodextrin in longitudinal and transverse relaxation rates of the corresponding 1:2 complexes and determination of the orientation of the guest inside the host capsule. *Chirality* 2003; **15**(7): 654-659.

[4] **Yu SC, Bochot A, Bas GL, Chéron M, Mahuteau J, Grossiord JL, Seiller M, Duchêne D.** Effects of camphor/cyclodextrin complexation on the stability of O/W/O multiple emulsions. *Int J Pharm* 2003; **261**(1-2): 1-8.

[5] **Nikravesh MR, Jalali M**. The effect of camphor on the male mice reproductive system. *Urol J* 2004; **1**(4): 268-272.

[6] **Goel HC, Singh S, Adhikari JS, Rao AR.** Radiomodifying effect of camphor on the spermatogonia of mice. *Jpn J Exp Med* 1985; **55**(6): 219-223.

[7] **Jacobziner H, Raybin HW.** Camphor poisoning. *Arch Pediatr* 1962; **79**: 28-30.

[8] **Riggs J, Hamilton R, Homel S, McCabe J.** Camphorated oil intoxication in pregnancy; report of a case. *Obstet Gynecol* 1965; **25**: 255-258.

[9] **Ford MD, Delaney KA, Ling LJ, Erickson T.** *Clinical Toxicology*. Philadelphia: WB Saunders, 2001. 345-350.

[10] **Taylor P.** Handling: the reproductive cycle and mating. *In*: *Practical Teratology*, London: Academic Press, 1986. 3-9.

[11] **Dorsun A, Sendag F, Terekn MC, Yilmaz H, Oztekin K, Baka M, Tanyalcin T**. Morphometric changes in the endometrium and serum leptin levels during the implantation period of the embryo in the rat in response to exogenous ovarian stimulation. *Fertil Steril* 2004; **82**(3): 1121-1126.

[12] **Jamshidzadeh A, Sajedianfard J.** Effects of subchronic exposure to camphor on male reproductive tract in rats. *Toxicol Lett* 2006; 1645: S1-S324.

[13] **Schlumpf M, Durrer S, Faass O, Ehnes C, Fuetsch M, Gaille C, Henseler M, Hofkamp L, Maerkel K, Reolon S, Timms B, Tresguerres JA, Lichtensteiger W.** Developmental toxicity of UV filters and environmental exposure: a review. *Int J Androl* 2008; **31**(2): 144–151**.**

[14] **Manoguerra AS, Erdman AR, Wax PM, Nelson LS, Caravati EM, Cobaugh DJ, Chyka PA, Olson KR, Booze LL, Woolf AD, Keyes DC, Christianson G, Scharman EJ, Troutman WG**; American Association of Poison Control Centers. Camphor Poisoning: an evidence-based practice guideline for out-of-hospital management. *Clin Toxicol (Phila)* 2006; **44**(4): 357-370.

[15] **Tinwell H, Lefevre PA, Moffat GJ, Burns A, Odum J, Spurway TD, Orphanides G, Ashby J.** Confirmation of uterotrophic activity of 3-(4-methylbenzylidine) camphor in the immature rat. *Environ Health Perspect* 2002: **110**(5): 533-536.

[16] **Leuschner J**. Reproductive toxicity studies of D-camphor in rats and rabbits. *Arzneimittelforschung* 1997; **47**(2): 124-128.

[17] **Soucy NV, Parkinson HD, Sochaski MA, Borghoff SJ.** Kinetics of genistein and its conjugated metabolites in pregnant Sprague-Dawley rats following single and repeated genistein administration. *Toxicol Sci* 2006; **90**(1): 230-240.

[18] **Blackmon WP, Curry HB**. Camphor poisoning; report of a case occurring during pregnancy. *J Fla Med Assoc* 1957; **43**(10): 999-1000.

[19] **Yoshimura K, Fujii J, Tanimoto A, Yutsudo T, Kashimura M, Yoshida S.** Effects of Shiga toxin 2 on lethality, fetuses, delivery, and puerperal behavior in pregnant mice**.** *Infect Immun* 2000; **68**(4): 2254-2258.

[20] **Chan LY, Chiu PY, Lau TK**. An *in vitro* study of ginsenoside Rb1-induced teratogenicity using a whole rat embryo culture model. *Hum Reprod* 2003; **18**(10): 2166-2168

[21] **Abdel-Meguid TM.** The foundations of embryology, Riyadh: *Scientific Publishing King Saud University*, 1999.

[22] **Wei P, Yuan JX, Jin X, Hu ZY, Liu YX.** Molsidomine and *N*-omega-nitro-*L*-arginine methyl ester inhibit implantation and apoptosis in mouse endometrium. *Acta Pharmacol Sin* 2003; **24**(12): 1177-1184.

[23] **Osman HS.** General Physiology, Alexandria: *Publishing: Young University Institution*, 1999.

[24] **Abu Sena JMI, Aljanzori MAI, Alcharhabbi AM, Kamel AW, Ibrahim IM, Alshabka, HA, Assuit ANI, Meseiri MA, Alnahas AI, Kamel KI.** Zoology. Amman: Dar Al-Fikr Print Pub Dist. 2003.

[25] **Albnhawi MA, Rushdi MA, DamianES, Shalaby AA, Saud FA**. Zoology. 5th ed, Riyadh, KSA: King Saud University P. 1990.

[26] **Smith MS, Freeman ME, Neill JD.** The control of progesterone secretion during the estrous cycle and early pseudopregnancy in the rat: prolactin, gonadotropin and steroid levels associated with rescue of the corpus luteum of pseudopregnancy, *Endocrinology* 1975; **96**(1): 219-226.

دراسات مظهرية وقياسية على تطور الجنين في الفئران الحوامل المعالجة بالكافور

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المستخلص. يستخدم الكافور منذ القدم في غسل الموتى في المملكة العربية السعودية. لذا أجري هذا البحث لدراسة تأثير الكافور على الجرذان والأجنة من نوع Sprague-Dawley. قسمت الجرذان الحوامل (٣٦) إلى ٤ مجموعات (٩) k وحقنت ٣ مجموعات منها في التجويف البريتوني بجرعات مختلفة من محلول الكافور المائي (5 و١٠ و٢٠ ملغ كافور/كغ من وزن الجسم). أما المجموعة القياسية فقد حقنت بنفس الجرعات من الماء المقطر. حفظت الحيوانات المعاملة في غرف ذات درجة حرارة ثابتة (٢٢°± ٢° C) وتحت فترة ضوئية تتراوح مابين ١٢ ساعة ضوء و١٢ ساعة ظلام.

خدرت ٣ حيوانات من كل مجموعة في نهاية الأسبوع ١ و٢ و٣ من الحمل، ثم استخرجت عينات البلازما والأجنة. أظهرت النتائج زيادة معنوية في وزن الجسم للجرذان الحوامل في الأسبوع الأول من الحمل للمجموعة الثانية (١٠ ملجم/كجم)، وفي الأسبوع الثاني من الحمل للمجموعة الثالثة (٢٠ ملجم/كجم)، مقارنة بالمجموعة الضابطة. التحليل الهرموني لم يظهر فروقًا معنوية مع جميع الجرعات المستخدمة. كما لوحظ نقص معنوي في طول ووزن الأجنة، وزيادة عدد الأجنة الميتة وغير المكتملة النمو في المجموعة ٣ (٢٠ ملجم/ كجم). وبهذا فإن الدراسة قد أظهرت أن الكافور له تأثير سلبي على الأجنة، لذلك نوصي بالحذر عند استخدامه وبالأخص للحوامل.