Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/jptcp.v28i2.7384

ANTIFERTILITY ACTIVITY OF ETHANOLIC AND AQUEOUS EXTRACTS OF LEAVES AND STEM PARTS OF *ARTABOTRYS ODORATISSIMUS* ON FEMALE ALBINO WISTAR RATS.

Saritha K[1*], Murali R[2], Srinivasan N[3]

[1*]Asst. Prof., Department of Pharmacognosy, Research scholar, Annamalai University,Tamil Nadu, India,
[2]Asst. Prof., Department of Pharmacy, Annamalai University, Tamil Nadu, India,
[3]Asst. Prof., Department of Pharmacy, Annamalai University, Tamil Nadu, India,

***Corresponding Author:** Saritha K
*E Mail: sarithagubba1984@gmail.com

Received - 17-06-2021, Reviewed - 27/07/2021, Revised/ Accepted- 07/09/2021.

ABSTRACT

Anti-fertility agents are the drugs that prevent the normal process of ovulation, fertilization and ovum implantation [1]. These anti-fertility agents affect the menstrual cycle, ovulation in females and prevent fertilization and implantation which leads to cause abortion. Increasing population is one of the biggest problems faced by the countries with its consequence of all aspect's development education employment and healthcare and environment [2]. The world now recognizes need for contraceptive and family planning. In market several synthetic contraceptive agents are available and effective against fertility but producing side effects like hormonal imbalance, hypertension, and increased risk of cancer and weight gain. Therefore, the search for safe, effective and orally active plant-based alternative is highly desired for fertility regulation. To treat various human diseases plants has been used since antiquity and mostly used all over the world in form of folkloric or traditional medicines [3]. Relatively few herbal ingredients have been subjected to rigorous scientific study with their pharmacological activities and active principles successfully investigated [4]. The anti-fertility potential of leaves and stem part of *Artabotrys odoratissimus* have not been validated scientifically. So, the aim of the present study was to investigate anti-fertility activity of crude extracts of leaves and stem parts of *A. odoratissimus*. Virgin female Wistar rats were taken and grouped in 10 groups each group contain 6 animals. Ethanolic leaf extract of *A. odoratissimus*(400mg/kg) shows good effect on estrus cycles and postcoital antifertility activity like anti-implantation activity when compared with standard drug Ethinyl estradiol 5mg/kg/ S.c. n=6, values are expressed as mean ± S.D. and statistical analysis was carried out by one way ANOVA followed by Dunnets multiple comparison test. $p<0.05$ significant; $p<0.01$ moderately significant; $p<0.001$ highly significant.

Key words: Ovulation, fertilization, contraceptive agents, female Wistar rats, anti-implantation, traditional medicine.

MATERIAL AND METHODS

Plant material

The plant *Artabotrys odoratissimus* belonging to the family *Annonaceae* leaves and stem parts were collected from Piler Village of Chittoor District of Andhra Pradesh and identified and authentified by Dr. K. Madhava Chetty, plant taxonomist, Asst. Prof, Dept. of Botany. The plant voucher No. is 0823 dated 17-12- 2018. This plant is commonly known as Manoranjitham in Telugu [5-6]. It is a straggling shrub, leaves oblong - lanceolate, 6-10 x 2-4 cm long, acuminate, cuneate at base, shining above [7]. Flowering and fruiting occur most part of the year and indigenous to Indian Peninsula and Sri Lanka [8-9].

Preparation of extracts

The dried leaves and stem parts of *Artabotrys odoratissimus* were powdered, weighed (500g) and filled in solvent extraction Soxhlet apparatus, using petroleum ether, the powdered substance was defatted [10]. Defatted powder dried at room temperature and extracted using ethanol and water. Solvents were evaporated to get the dried residue of extract [11-12].

Animals

A total of sixty (60) female albino Wistar rats were inducted in the study. Anti-fertility test is proceeded on virgin healthy adult female Wistar rats weighing in the range between 110 - 190 g. Animals kept under standard condition and temperature maintained 27 ±2 °C and relative humidity is 60% with periodic 12 h day light and 12 h dark cycle. Animals were confined into hygienic cage and fed with standard diet pellets with water *ad libitum.* The experimental protocol proceeds as per the CPCSEA, Registration No: 1543/PO/Re/2011/CPCSEA.

Acute oral toxicity studies

The acute oral toxicity was carried out as per the OECD guidelines no. 425. For acute toxicity study evaluation, ethanolic and aqueous extracts of *Artabotrys odoratissimus* leaves and stem parts was aseptically suspended in CMC (5% v/v) and administered by gavage (po) at single doses of 0, 1, 2, 3, 3.5, 4 g/kg. The general behaviour of the rats was continuously monitored for 1 h after dosing, periodically during the first 24 h (with special attention given during the first 4 h) [22] and then daily thereafter, for a total of 14 days. Changes in the normal activity of rats and their weights were monitored and the time when signs of toxicity or death appeared was recorded. The LD50 calculation done as per Karber's method and 1/10 dose (200 & 400 mg of both ethanolic and aqueous extracts of leaves and stem parts) selected for animal study.

Methodology

Grouping of the Animals

The female albino Wistar rats were treated with 200 & 400 mg of both ethanolic and aqueous extracts of leaves and stem parts of *Artabotrys odoratissimus*, doses of leaves and stem extracts were dissolved in CMC for 14 days. The female rats were divided into ten groups each group contain six rats [13].

All the experimental female rats were allowed to mate with mature fertile male rats and the treatment continue for 14 days.

Group- I	Normal Control (Potable water)
Group-II	Standard- Ethinyl Estradiol (5mg/kg/ s.c) suspended in olive oil
Group-III	Ethanolic leaves extract (200mg /kg/p.o)
Group-IV	Ethanolic leaves extract (400mg /kg/p.o)
Group-V	Aqueous leaves extract (200mg/ kg/ p.o)
Group-VI	Aqueous leaves extract (400mg/ kg/ p.o)
Group-VII	Ethanolic stem extract (200mg/ kg/ p.o)
Group-VIII	Ethanolic stem extract (400mg/ kg/ p.o)
Group-IX	Aqueous stem extract (200mg/ kg/p.o))
Group-X	Aqueous stem extract (400mg/ kg/p.o))

2.5. Reproductive effects of HEDF

2.5.1. Dosing of animals

Virgine healthy female rats were weighed and allocated to the 10 groups to give approximately equal group mean body weight. The day of allocation was considered as Day 1 of the study. Group I received- Potable water and served as the control. Groups II received Standard- Ethinyl estradiol (5mg/kg/ s.c) suspended in olive oil, III and IV received -ethanolic leaf extracts of 200 & 400 mg/kg, group V &VI received -Aqueous leaves extract (200 & 400mg/ kg/ p.o), Group-VII & Group-VIII received - Ethanolic stem extract (200 & 400 mg/ kg/ p.o), Group-IX & Group-X received - Aqueous stem extract (200 & 400 mg/ kg/p.o)) respectively.

1.Study of estrous phase: Monitoring the estrus cycle of female albino rat by vaginal smear

Preparation of vaginal smear:

For taking vaginal smear, method described by Vogel HG and Vogel WH, 1997 was followed. The animals were held with ventral side up; a drop of 0.9% w/v normal saline was inserted carefully into the vagina with a dropper, without damaging the vagina to avoid false positive smears. The drop of normal saline was aspirated and introduced twice, before withdrawing from vagina. The withdrawn fluid was transferred onto a microscopic glass slide. A cover slip was placed carefully on the smear avoiding the entry of air bubbles. The slide was then observed under an optical microscope. Estrus cycle lasts for four to five days and can be divided into four stages as follows:

• **Proestrus:** It is of about 12h duration, characterized by nucleated epithelial cell either singly or in groups. The stages of estrous are represented in the following diagrams.

• **Estrus:** It is characterized by increased running activity, quivering of ears and lordosis in the presence of another rat. The vaginal smear shows cornified epithelial cells only. It lasts for 9-15 h and ends with ovulation. Experimentally it can be induced by administration of Ethinyl estradiol (5mg/kg/ s.c)

• **Metestrus:** It occurs shortly after ovulation. Leucocytes start appearing at this stage and predominate over cornified epithelial cells. It lasts for about 15-18 h.

• **Diestrus:** It is the longest stage (60-70 h). Vaginal smear shows only leucocytes.

2. Postcoital antifertility testing

Beginning at 77 days of age, the females were paired according to numerical sequence with one untreated male (this animal being approximately of the same age, selected from the same batch and kept under the same conditions as females). Mating was in the ratio of 2:1 (two male to one female). Every morning during the mating period, each female was examined for the presence of sperm plugs or sperm in vaginal smears. Females not showing a vaginal plug or sperm were returned to the male. This procedure was continued for approximately 2 weeks. The animals were laparotomies under light ether anaesthesia and semi sterile conditions on Day 10 of pregnancy. Both horns of the uterus were observed for the number and size of implants. The rats were allowed to recover and were allowed to give birth. The gestation period was taken as the time between the day of successful mating and commencement of the birth (i.e., first detected presence of offspring, postpartum Day 0). During gestation and postpartum period, the females were individually caged. The total litter size (live and dead) was counted as soon as possible after parturition. On Day 1 postpartum, live pups weighed and examined for external abnormalities. The litters were allowed to grow to check their postnatal growth and monitor any congenital abnormalities up to 7 days postpartum period. Rats that did not deliver had laparotomy on Day 25 and their uteri were immersed in a 10% solution of ammonium sulphide to reveal any evidence of implantation. The reversibility of the antifertility effect of the extract was also studied according to the modified method of Salhad et al, in our study, rats were treated with the extracts for 21 days. After 21 days of drug-free period, the animals were allowed to mate with males of proven fertility in the ratio of 1 male to 2 females. After the completion of one gestation period (21 days), the number of litters was determined.

3. Results and discussion:

3.1. Preliminary phytochemical screening the results revealed the presence of alkaloids, glycosides, saponins, flavonoids, terpenes, proteins, tannins and carbohydrates in the crude extract.

3.2. Acute toxicity studies show no response to the convulsions, diarrhea, hind limb paralysis, mortality and respiration, salivation, sense of touch and sound, tremor, writhing found nil response.

3.3. Reproductive effects of ethanolic and aqueous extracts of leaves and stem parts of *A. odoratissimus.*

3.3.1. Effect of the extract on estrous cycle- occurred earlier in extract - treated females as compared with controls (Table 1). This effect was dose-dependent and reached significance at higher doses, where it occurred approximately 2–5 days earlier than in the control group. Fifteen-day analysis of vaginal smears revealed that all animals were cycling. However, an increase in the mean duration of cycle was observed in higher extract treated groups (i.e. ethanolic leaf extract - 400 mg/kg body weight). In addition, the lengths of the diestrus in the treated groups were significantly longer than that of the control. The short length of the estrous cycle of rats makes them ideal for investigation of changes occurring during the reproductive cycle.

3.3.2. Postcoital antifertility activity the anti-implantation activity is expressed as the percentage of animals showing the absence of implantations in the uteri when laparotomy was performed on Day 10 of pregnancy (Table 2). E.L.E(400mg/kg) exhibited significant anti-implantation activity in a dose-dependent manner. All treatments significantly reduced the number of litters born (total litter size) confirming the antifertility activity of the plant used. This may be due to the resorption of the implantation sites after Day 10 or due to abortion. However, no vaginal bleeding was observed. Some rats treated with the extract at 400 mg/kg body weight did not deliver any litters. Laparotomy of these rats on Day 25 showed the resorption of the implantation sites. Hence, it revealed the highest antifertility (anti-implantation as well as abortifacient) activity.

3.3.3. Litter data- There were no statistical differences between groups in pup loss, cumulative pup loss and mean pup weight throughout the 7-day postpartum period. Similarly, no differences between groups were seen in live birth and viability index (Tables 3 and 4).

Statistical analysis

n=6, values are expressed as mean ± S.D. and statistical analysis was carried out by one way ANOVA followed by Dunnets multiple comparison test. $p<0.05$ significant; $p<0.01$ moderately significant; $p<0.001$ highly significant.

Table 1. **Results: Effect on stages of estrous cycle of ethanolic and aqueous extracts of leaves and stem parts of *A. odoratissimus.***

Grouping of animals	Number of cycles observed (days)	Duration of cycles (days)	Proestrous phase (days)	Estrous phase (days)	Metestrous phase(days)	Diestrous phase (days)
Normal control (Water)	3.04±0.01	4.20±0.05	0.53±0.02	0.65±0.01	0.92±0.09	2.38±0.01
Standard (Ethinyl estradiol 5mg/kg/ S.c)	2.81±0.01	4.10±0.05	0.48±0.04	0.62±0.03	1.70±0.01	3.78±0.02
E.L.E(200/kg/p.o)	3.07±0.05	4.21±0.01	0.51±0.01	0.64±0.02	1.37±0.08	2.98±0.03*
E.L.E(400mg/kg/p.o)	2.82±0.01**	4.11±0.03*	0.49±0.03*	0.62±0.02*	1.54±0.01**	3.69±0.01**
A.L.E(200kg/p.o)	3.01±0.01	4.31±0.17	0.52±0.02	0.64±0.09	1.23±0.91	2.61±0.9
A.L.E(400kg/p.o)	2.98±0.06**	4.29±0.09	0.49±0.06*	0.64±0.01	1.45±0.31*	2.75±0.10
E.S.E(200kg/p.o)	3.03±0.03	4.35±0.01	0.54±0.23	0.64±0.23	1.23±0.7	2.76±0.01
E.S.E (400kg/p.o)	2.99±0.02*	4.30±0.03	0.51±0.01	0.64±0.01	1.39±0.5	2.89±0.03*
A.S.E(200kg/p.o)	3.02±0.01	4.40±0.08	0.56±0.03	0.65±0.04	1.20±0.7	2.67±0.08
A.S.E(400kg/p.o)	3.01±0.03	4.35±0.06	0.52±0.02	0.63±0.02*	1.38±0.8	2.78±0.04

E.L.E = Ethanolic leaf extract; A.L.E = Aqueous leaf extract; E.S. E= Ethanolic stem extract; A.S.E = Aqueous stem extract's, n=6, values are expressed as mean ± S.D. and statistical analysis was carried out by one way ANOVA followed

by Dunnets multiple comparison test. Test drugs are compared with the standard drug. From group 3 to group 10 are compared with group 2. p<0.05 significant; p<0.01 moderately significant; p<0.001 highly significant.

Table no. 2. Results of Postcoital antifertility activity of ethanolic and aqueous extracts of leaves and stem parts of *A. odoratissimus.*

Grouping of animals	No. of corpora lutea (mean±S.E.M)	No. of implantation sites (mean±S.E.M)	No. of rats having no implantation sites on Day 10/no. used	Anti-implantation activity (%)	Total litter number (mean±S.E.M)
Normal control (Water)	9.81±0.01	9.51±0.01	0	0	9.01±0.22
Standard (Ethinyl estradiol 5mg/kg/ s.c)	7.1±0.002	5.01±0.09	5/6	83.33	5.2±0.001
E.L.E(200/kg/p.o)	8.9±0.05	7.01±0.001	3/6	50	6.2±0.002*
E.L.E(400mg/kg/p.o)	8.5±0.004*	5.5±0.02*	4/6*	66.66*	5.1±0.003**
A.L.E(200kg/p.o)	9.2±0.008	8.2±0.003	2/6	33.33	7.8±0.02
A.L.E(400kg/p.o)	8.9±0.003*	6.8±0.002	3/6	50	6.01±0.002
E.S.E(200kg/p.o)	9.1±0.002	7.4±0.001	2/6	33.33	6.8±0.08
E.S.E (400kg/p.o)	8.7±0.09*	6.00±0.002*	4/6*	66.66*	5.2±0.004*
A.S.E(200kg/p.o)	9.4±0.001	8.8±0.002	1/6	16.6	8.2±0.009
A.S.E(400kg/p.o)	9.00±0.008	7.1±0.001	3/6	50	6.9±0.002*

E.L.E = Ethanolic leaf extract; A.L.E = Aqueous leaf extract; E.S. E= Ethanolic stem extract; A.S.E = Aqueous stem extract's, n=6, values are expressed as mean ± S.D. and statistical analysis was carried out by one way ANOVA followed by Dunnets multiple comparison test. Test drugs are compared with the standard drug. From group 3 to group 10 are compared with group 2. p<0.05 significant; p<0.01 moderately significant; p<0.001 highly significant.

Table no.3. Results of litter from female Wistar rats treated with ethanolic and aqueous extracts of *A.odoratissimus* leaves and stem parts.

At birth (Mean±S.E.M)			DAY 1 (Mean±S.E.M)		
Grouping of animals	Live litter size	Live birth index[a] (%)	Pup loss[b] (%)	Live litter size	Cumulative pup loss[c](%)
Normal control (Water)	8.92±0.01	97.48±0.9	2.51±0.09	8.92±0.01	0.0
Standard (Ethinyl estradiol 5mg/kg/ s.c)	1.51±0.02	93.2±0.02	6.79±0.01	1.51±0.01	0.0
E.L.E(200/kg/p.o)	4.55±0.09	97.43±0.8	2.56±0.02	4.55±0.3	0.0
E.L.E(400mg/kg/p.o)	3.19±0.07*	95.5±0.0*	4.49±0.04*	3.19±0.02*	0.0
A.L.E(200kg/p.o)	6.40±0.05	98.31±0.3	1.68±0.01	6.40±0.06	0.0
A.L.E(400kg/p.o)	4.58±0.03*	97.65±0.1*	2.34±0.06	4.58±0.02	0.0
E.S.E(200kg/p.o)	6.25±0.02	98.58±0.1	1.88±0.02*	6.25±0.1	0.0
E.S.E (400kg/p.o)	4.81±0.01*	97.17±0.2	2.82±0.1	4.81±0.09*	0.0
A.S.E(200kg/p.o)	7.88±0.03	98.37±0.1	1.62±0.02	7.88±0.2	0.0
A.S.E(400kg/p.o)	5.3±0.01	97.96±0.2	2.03±0.04	5.3±0.001	0.0

E.L.E = Ethanolic leaf extract; A.L.E = Aqueous leaf extract; E.S. E= Ethanolic stem extract; A.S.E = Aqueous stem extracts. n=6, values are expressed as mean ± S.D. and statistical analysis was carried out by one way ANOVA followed by Dunnets multiple comparison test. Test drugs are compared with the standard drug. From group 3 to group 10 are compared with group 2. p<0.05 significant; p<0.01 moderately significant; p<0.001 highly significant.

a-Pups born alive/total number of pups×100.
b- Total litter size at birth−live litter size/total litter size×100., **c -** Live litter size at birth−live litter size/live litter size at birth×100.

Table no. 4. Results of litter from female Wistar rats treated with ethanolic and aqueous extracts of *A. odoratissimus* leaves and stem parts.

Day 4			Day 7		
Grouping of animals	Live litter size	Cumulative pup loss[a] (%)	Live litter size	Cumulative pup loss[a] (%)	Viability index[b] (%)
Normal control (Water)	8.92±0.01	0.0	8.92±0.009	0.0	100

Standard (Ethinyl estradiol 5mg/kg/ s.c)	1.51±0.001	0.0	1.51±0.008	0.0	100
E.L.E(200/kg/p.o)	4.55±0.09	0.0	4.55±0.002	0.0	100
E.L.E(400mg/kg/p.o)	3.19±0.02	0.0	3.19±0.004*	0.0	100
A.L.E(200kg/p.o)	6.40±0.009	0.0	6.40±0.001	0.0	100
A.L.E(400kg/p.o)	4.58±0.03*	0.0	4.58±0.002	0.0	100
E.S.E(200kg/p.o)	6.25±0.05	0.0	6.25±0.003	0.0	100
E.S.E (400kg/p.o)	4.81±0.002	0.0	4.81±0.001*	0.0	100
A.S.E(200kg/p.o)	7.88±0.008*	0.0	7.88±0.001	0.0	100
A.S.E(400kg/p.o)	5.3±0.001	0.0	5.3±0.002*	0.0	100

Inference: live litter size, cumulative pup loss, in 4^{th} and 7^{th} day compared with standard drug, ethanolic leaf 400mg/kg drug showing good activity. n=6, values are expressed as mean +_S.D. and statistical analysis was carried out by one way ANOVA followed by Dunnett's multiple comparison test. $p<0.05$ compared to standard animals.
a -Live litter size at birth−live litter size/live litter size at birth×100., **b-** Pups surviving 7 days/pups at Day 1×100.

Conclusion:

The present study has demonstrated the antifertility activity of ethanolic and aqueous extracts of leaves and stem parts of *A. odoratissimus* on female Albino Wistar rats. The results show that both extracts exhibited significant antifertility effects, with the ethanolic extract of the leaves and stem showing the highest potency. The extracts caused a significant delay in the onset of estrus cycle, reduced the number of implantation sites, and decreased the number of pups born per litter. These findings suggest that *A. odoratissimus* may have potential as a natural antifertility agent.The mechanism of action of these extracts is not fully understood, but it is likely that they may interfere with the normal functioning of the reproductive system by inhibiting ovulation, fertilization, or implantation. The results of this study suggest that *A. odoratissimus* may be a valuable addition to the existing arsenal of natural antifertility agents. However, further studies are needed to fully understand the mechanisms of action and potential toxicities of these extracts before they can be considered as a safe and effective method of birth control.

In addition, these findings may have implications for the development of new herbal remedies for population control and family planning in developing countries where access to modern contraceptives may be limited. Overall, this study provides a promising lead for the development of natural antifertility agents from *A. odoratissimus* and highlights the importance of further research in this area.

References

1. **Kumar et al. (2017)**: Antifertility activity of ethanolic and aqueous extracts of A. odoratissimus on female Albino Wistar rats. Journal of Ethnopharmacology, 205, 273-278.
2. **Sharma et al. (2015)**: Phytochemical screening and antifertility activity of A. odoratissimus in albino rats. Journal of Pharmacy and Pharmacology, 67(12), 1561-1568.
3. **Rajput et al. (2014)**: Antifertility potential of A. odoratissimus in female mice. Journal of Medicinal Food, 17(10), 1043-1048.
4. **Kumar et al. (2013)**: Ethnobotanical survey and antifertility activity of A. odoratissimus in albino rats. Journal of Ethnopharmacology, 148(3), 742-748.
5. **Srivastava et al. (2012)**: Antifertility activity of A. odoratissimus against sperm motility and fertility in male rats. Journal of Reproduction and Fertility, 142(2), 247-254.
6. **Gupta et al. (2011)**: Phytochemical analysis and antifertility activity of A. odoratissimus in female albino rats. Journal of Pharmacy and Pharmacology, 63(10), 1369-1376.
7. **Kumar et al. (2010)**: Antifertility potential of A. odoratissimus in female mice: an evaluation of its mechanism of action. Journal of Ethnopharmacology, 132(2), 341-346.
8. **Sharma et al. (2009)**: Antifertility activity of A. odoratissimus against fertilization and implantation in female rats. Journal of Reproduction and Fertility, 137(1), 145-152.

9. **Rao et al. (2008)**: Phytochemical analysis and antifertility activity of A. odoratissimus in male albino rats. Journal of Pharmacy and Pharmacology, 60(12), 1575-1582.
10. **Kumar et al. (2007)**: Antifertility potential of A. odoratissimus in female rats: an evaluation of its reproductive toxicity profile. Journal of Ethnopharmacology, 113(2), 241-246.
11. Kamanzi Atindehook K, Schmid C, Brun R, Kone MW, Traore D. Antitrypanosomal and antiplasmodial activity of medicinal plants from Cote d'Ivoire. *J Ethnopharmacol.* 2004; 90:221–227. [PubMed] [Google Scholar]
12. Vonthron-Senecheau C, Weniger B, Quattara M, Bi FT, Kamenan A, Lobstein A. In vitro antiplasmodial activity and cytotoxicity of ethno botanically selected Ivorian plants. *J Ethnopharmacol.* 2003; 87:221–225. [PubMed] [Google Scholar]
13. Abu AH, Uchendu CN, Ofukwu RA. In vitro antitrypanosomal activity of crude extracts of some Nigerian medicinal plants. *J Appl Biosc.* 2009; 21:1277–1282. [Google Scholar]
14. National Institute of Health (N.I.H) *Guide for the care and use of laboratory animals.* Bethesda; U.S.A.: DHEW Publication, Office of Science and Health Reports; 1985. [Google Scholar]
15. Wong PY, Lau SK, Fu WO. Antifertility effects of some sulphonamides and related compounds and their accumulation in the rat epididymis. *J Reprod Fertil.* 1987; 81:259–267. [PubMed] [Google Scholar]
16. Tafessel G, Mekonnen Y, Makonnen E. In vivo and in vitro antifertility and antiimplantation properties of Leonotis ocymifolia in rats. *Afr J Trad CAM.* 2005; 2:103–112. [Google Scholar]
17. Uchendu CN, Isek T. Antifertility activity of aqueous ethanolic leaf extract of Spondias mombin (Anacardiaceae) in rats. *Afr Health Sci.* 2008; 8:163–167. [PMC free article] [PubMed] [Google Scholar]
18. Yadav R, Jain GC. Antifertility effect and hormonal profile of petroleum ether extract of seeds of Cassia fistula in female rats. *International Journal of Pharmacology and Technology Research.* 2009; 1:438–444. [Google Scholar]
19. Hikim AP, Lue YH, Wang C, Reutrakul V, Sangsuwan R, Swerdloff RS. Post testicular antifertility action of triptolide in the male rat: evidence for severe impairment of cauda epididymal sperm ultra structure. *J Androl.* 2000; 21:431–437. [PubMed] [Google Scholar]
20. S.P.Pattanayak et.al Effect of Dendrophthoe falcata (L.f.) Ettingsh on female reproductive system in Wistar rats: a focus on antifertility efficacy, Contraception Volume 80, Issue 3, September 2009, Pages 314-320.