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MEDICINAL PLANTS WITH POTENTIAL ANTIFERTILITY ACTIVITY: A REVIEW OF SEVENTY FIVE YEARS OF RESEARCH (1944-2019)

Kajal Jha[1], Amulya Dahal*[2], Srishti Shrestha[3] and Prof. Dr. Naredra Nath[4]

[1]Assistant Professor, Department of Stree Roga Tatha Prasuti Tantra, Ayurveda Campus and Teaching Hospital, Kirtipur, Kathmandu, Nepal.
[2]PG Scholar, Department of Kayachikitsa, Ayurveda Campus and Teaching Hospital, Kirtipur, Kathmandu, Nepal.
[3]Ayurveda Medical Officer, Narayani Zonal Ayurveda Health center, Hetauda, Makawanpur, Nepal.
[4]Head of Department, Department of Dravyaguna.

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***Corresponding Author: Dr. Amulya Dahal**

PG Scholar, Department of Kayachikitsa, Ayurveda Campus and Teaching Hospital, Kirtipur, Kathmandu, Nepal.

ABSTRACT

Fertility Control is an issue of global public health concern. Currently, contraceptives containing estrogen and progesterone are extensively being used but due to serious adverse effects produced by them, the need to develop newer molecules from medicinal plants that could be better option for antifertility activity. In this present review, an attempt is made to summarize the result of information gathered on medicinal plants used for anti-fertility conducted in last seventy five years (from 1946-2019). Review is done by analyzing various classical text books, reference books, articles, peer-reviewed papers from worldwide accepted scientific databases. Total 75 plants under 48 families are reported in this review are having different antifertility activities.

KEYWORDS: Antifertility, Medicinal Plants, Contraceptives, Anti-implantation, Abortifacient.

INTRODUCTION

From an estimated 7.7 billion people worldwide in 2019, the medium-variant projection indicates that the global population could grow to around 8.5 billion in 2030, 9.7 billion in 2050, and 10.9 billion in 2100.[1] Such Increasing number of Population has got a deleterious effect on the health of mother and child and hinders social and economic progress of the society. So Fertility Control is an issue of global public health concern.

Antifertility drug, also known as Oral Contraceptives refers to the substances used to prevent or inhibit pregnancy. These substances ranges from natural agents present as herbal derivatives used from traditional methods to chemical synthetic moiety.[2] The primary requisite of an antifertility agent for human is that it should be non-toxic, non-teratogenic and should not interfere with the normal metabolic and behavioral process. Further, the method should be reversible. Therefore, an exhaustive and prolonged study on the safety and efficacy of such antifertility agents including their effect on progeny is a must. The selection and use of contraceptive methods are influenced by their intrinsic characteristics and social acceptability. The intrinsic characteristics include: medical safety, effectiveness, continuity of use and reversibility. The main aspects of social acceptability are: personal, cultural, religious, sexual, medical, organizational, logical, economic, political and philosophical.[3]

Currently, Although contraceptives containing estrogen and progesterone are effective and popular used for family planning, but due to serious adverse effects produced by synthetic steroidal contraceptives such as toxicity to gonads, Infertility on temporary or permanent basis, testicular germ cell cancer, breast/ Prostate cancer, brain developmental problems, endometriosis, obesity, cholelithiasis, gastric trouble, asthma, venous thromboembolism and early puberty etc, many countries have already banned the use of hormonal contraceptives. The risks associated to the drugs have triggered the need to develop newer molecules from medicinal plants that could be effectively used in the place of pills for antifertility activity.

In this present review, attempt will be made to summarize the result of research work conducted in last seventy five years (from 1946-2019). Total 75 plants under 48 families are reported in this review are having

different antifertility activities. The list of potential antifertility plants are presented with their scientific name, family, parts used, main findings of the publication and year of publications are summarized in the Table 1.

METHODOLOGY

A bibliographic investigation was done by analyzing various classical text books, reference books, articles, peer-reviewed papers, as well consultation of worldwide accepted scientific databases. We performed Google Scholar, Hinari, and PubMed searches using terms such as “Antifertility”, “Anti-implantation”, “Antiovulation”, “Antispermatogenic”, "Abortifacient" "Contraceptives", "Medicinal Plants".

Table 1: Review of Research Work Conducted on Plants Used As Herbal Contraceptives In Last Eight Decades.

S.N.	Name Of Plants	Family	Scientific work done by	Part used of plant	Major Findings	Publication Year
1.	*Abroma augusta* (L.) L.f.	*Malvaceae*	(4)	Roots	Anti-Ovulatory, anti-implantation or abortifacient activity	1966
			(5)	Stem	Uterotonic activity exhibited when tested on isolated rat uterus, isolated uterine stripes of guinea pig, rabbit and humans and on dog uterus in situ.	1966
2.	*Abrus precatorius* L.	*Leguminosae*	(6)	Seed	Oxytocic activity was demonstrated in vitro guinea pigs.	1961
			(7)	Seed	Oil was given to albino rats and Swiss mice. The best effect (100%) was seen when extracts were fed orally to animals for 20 consecutive days before mating. A single oral dose of steroidal oil in post coital period produced 80% sterility in rats. Result in mice was also encouraging.	1967
3.	*Achyranthes aspera* L.	*Amaranthaceae*	(8)	Root	The ethanol extract of the root was screened for antifertility activity in proven fertile female albino rats at 200 mg/kg body weight and given orally on days 1–7 of pregnancy. The ethanol extract exhibited 83.3% anti-implantation activity when given orally at 200 mg/kg body weight. The rats, which continued their pregnancy, did not deliver any litters after their full term. Hence the combined antifertility (anti-implantation and abortifacient) activity of ethanol extract was 100%. The results suggest that the ethanol extract possess both anti-implantation and abortifacient activity.	2006
4.	*Actiniopteris radiata* (Sw.) Link	*Pteridaceae*	(9)	Whole plant	*Actioniopteris radiata* exhibited antifertility at lower dose (175 mg/kg), whereas at higher dose (350 mg/kg) results were complete contradictory to the lower dose i.e., at higher dose the plant extract exhibited fertility, this dual properties in the same plant enhanced the scope of further research at molecular level to evaluate active bio-compounds which could help in laying down standards for authentication of original drug	2019
5.	*Adiantum lunulatum* Burm. f.	*Pteridaceae*	(10)	Whole plant	Effects of crude extract, both alcoholic and decoction of whole plant of *Adiantum lunulatum* Burm was observed on the reproductive structures of male albino Rat after the oral administration of 100 mg/kg, 250 mg/kg; and 500 mg/kg body weight for 30, 60, 90 days respectively. A dose and duration dependent effects on testis, epididymis, vas deferens and accessory reproductive organs of the rats were observed. The treatment resulted in deformation in the germ cells of testis Leydig's cell were atrophied. No spermatozoa could be seen in the seminiferous tubules and were filled either with edematous fluid or degenerated cellular debris.	2010
6.	*Aegle marmelos* (L.) Corrêa	*Rutaceae*	(11)	Leaves	The aqueous leaf extract of *Aegle marmelos* cause antifertility effects among male mice.	2017
7.	*Albizia lebbeck* (L.) Benth.	*Leguminosae*	(12)	Pods	The methanolic extract of *A. lebbeck* pods causes spermatogenic arrest in male albino rats.	2004

8.	*Aloe vera* (L.) Burm.f.	*Xanthorrhoeaceae*	(6)	Leaves	Used as major ingredient of vegetable abortifacient pills in Europe and America but experimental findings on guinea pig uterus indicate that it possess very little oxytocic activity.	1961
9.	*Andrographis paniculata* (Burm.f.) Nees	*Acanthaceae*	(13)	Leaf	Dry leaf powder of *A. paniculata*, when fed orally to male albino rats, at a dose level of 20 mg powder per day for 60 days, resulted in cessation of spermatogenesis, degenerative changes in the seminiferous tubules, regression of Leydig cells and regressive and/or degenerative changes in the epididymis, seminal vesicle, ventral prostate and coagulating gland. There was reduction in the weight and fluid content of the accessory glands. The treatment also resulted in accumulation of glycogen and cholesterol in the testis, and increased activities of lactate dehydrogenase in testis and alkaline phosphatase in testis and ventral prostate. The results suggest antispermatogenic and/or antiandrogenic effect of the plant.	1990
10.	*Anodendron paniculatum* A.DC.	*Apocynaceae*	(14)	Roots	It has been claimed that Roots crushed in water, administered 3-5 times a day help in parturition.	1954
11.	*Apium graveolens* L.	*Apiaceae*	(4)	Seeds	Listed as an antifertility agent by 6 out of 10 sources consulted by the author.	1966
12.	*Artabotrys hexapetalus* (L.f.) Bhandari	*Annonaceae*	(15)	Leaf	Leaf extracts showed significant prolongation of dioestrus stage ($p<0.05$). Ethanol and water extracts showed anti-implantation effect.	2005
13.	*Artemisia vulgaris* L.	*Compositae*	(16)	Leaves	The methanolic plant extract of *A. vulgaris* has antifertility activity.	2014
14.	*Azadirachta indica* A.Juss.	*Meliaceae*	(17)	Seed	*A. indica* seed extracts significantly reduced the number of normal follicles in rats, with maximum reduction occurring with 6 mg PF of *Azadirachta* ex tract.	2005
			(18)	Seed Oil	*Neem* oil was investigated for its antifertility activity in vivo in rats, rabbits and rhesus monkeys. The drug is effective when applied before coitus but not so when applied during post-coital stages. It, therefore, appears to act mainly by its spermicidal effect. No alteration in the estradiol (E_2) and progesterone (P) values was observed after the application of the drug in monkeys.	
15.	*Bacopa monnieri* (L.) Wettst.	*Plantaginaceae*	(19)	Whole plant	*Brahmi* treatment causes reversible suppression of spermatogenesis and fertility, without producing apparent toxic effects.	2009
16.	*Balanites roxburghii* Planch	*Zygophyllaceae*	(20)	Fruits	The extracts of the fruits of the *Balanites Roxburghii* were tested at the dose of 300 mg/ kg and 600 mg/kg body weight. All these extracts did not exhibit any antiimplantation activity. However, abortifacient activity was exhibited by these extracts.	2006
17.	*Barleria prionitis* L.	*Acanthaceae*	(21)	Root	Oral administration of root extract of *Barleria prionitis* L. to male rats (100 mg/rat per day) for the period of 60 days did not cause body weight loss. The root extract brought about an interference with spermatogenesis. The round spermatids were decreased by 73.6% ($P \leq 0.001$). No significant change was found in the population of secondary spermatocytes. However, the population of preleptotene spermatocytes was decreased by 41.9%. The extract reduced the	2000

					fertility of male rats by 100%. Cross sectional surface area of Sertoli cells and mature Leydig cell numbers were significantly reduced (36.9%). The total protein, sialic acid contents of the testes, epididymides, seminal vesicle and prostate were reduced. Testicular glycogen contents were low. Antifertility effects of *Barleria* seemed to be mediated by disturbances in testicular somatic cells functions (Leydig and Sertoli cells) resulting in the physio-morphological events of spermatogenesis.	
18.	*Caesalpinia pulcherrima* (L.) Sw.	*Leguminosae*	(22)	Leaves	It can be concluded from the study that the ethanolic extract of *C. pulcherrima* Linn. Leaves have potent antiimplantation activity. The inhibition of implantations in mice might be due to the estrogenic nature of the extract.	2013
19.	*Calotropis gigantea* (L.) Dryand.	*Apocynaceae*	(23)	Aerial plant parts	methanolic extract of *C. gigantea* on male rats which can be a mile stone for further studies on development of orally effective, cheap, safe and reversible contraceptives for male.	2018
20.	*Calotropis procera* (Aiton) Dryand.	*Apocynaceae*	(24)	Root	Calotropin was found to inhibit spermatogenesis in male and induced abortion in pregnant females.	1990
21.	*Cannabis sativa* L.	*Cannabaceae*	(25)	Leaves	All the three extract i.e. aqueous, alcoholic and chloroform of *Cannabis sativa* leaves administered orally possess antifertility activity.	2013
22.	*Carica papaya* L.	*Caricaceae*	(26)	Leaves	The results of the study showed that administration of herbal oral contraceptive suspension at the dose of 200, 300 and 400 mg/kg body weight decreases the sperm count and causes marked alterations in the male reproductive organs and that the alterations are reversible after cessation of treatment. Treatment also had a reversible effect on suppression of fertility in males. Further, study did not show any toxic effects in treated rats.	2013
			(27)	Seed	The reduced cholesterol levels indicate decreased mobilization towards androgenesis which leads to decreased steroidogenesis and thereby inhibition of spermatogenesis in testes. The lowering of the 3βHSD and 17β-HSD activity levels in the testes suggest the antifertility agents interfere with steroid hormone biosynthesis, which ultimately result in impaired spermatogenesis and infertility.	2013
23.	*Cassia fistula* L.	*Leguminosae*	(28)	Seeds	The results of the present study indicate that the petroleum ether extract of *Cassia fistula* seeds possesses pregnancy terminating effect by virtue of anti-implantation activity.	2009
24.	*Celastrus paniculatus* Willd.	*Celastraceae*	(29)	Seeds	Biochemical, histochemical and histological studies of the effects of an oily extractive from the seeds of *Celastrus paniculatus* were done on the testes and liver of adult rats. The testis of treated animals showed vacuolization, germ cell depletion and arrest of spermatogenesis. The livers revealed focal necrosis in animals receiving 0.2 ml i.p. every other day for 30 days, but 45 days post treatment these lesions were absent. Intermediate repair and regenerative changes were apparent 30 days post treatment. These results indicate that *Celastrus*	1990

					paniculatus oil may have useful antifertility effects and that the degenerative changes seen in the liver are reversible with time.	
25.	*Citrus hystrix* DC.	*Rutaceae*	(30)	Fruit peel	An alcohol and chloroform extract of *Citrus hystrix* DC. fruit peel was investigated for antifertility activity in pregnant rats by oral administration at different periods of gestation. The extracts were found to effectively inhibit implantation, produce abortion and slightly hasten labor time when it was given from day 2 to 5, day 8 to 12 and day 15 until labor, respectively.	1985
26.	*Citrus limon* (L.) Osbeck	*Rutaceae*	(31)	Seeds	Alcoholic extract of *Citrus limon* seeds exerted reversible anti-fertility action on female albino mice. The ethyl acetate fractions (12–25 fractions) turned out to be the most active fraction of the extract. Anti-fertility activity of the extract and its fractions was found to be due to their antizygotic action	2005
27.	*Citrus medica* L.	*Rutaceae*	(32)	Fruit Peels	This study reveals significant values of anti-fertility activity of the alcoholic and chloroform extract as compared to oil extract on administration from days 1- 7 of the pregnancy which suggests that alcoholic and chloroform extract might be interfering in the preparation of uterus for implantation to occur.	2011
28.	*Cordia dichotoma* G.Forst.	*Boraginaceae*	(33)	Leaves	Hydroalcoholic extract of *Cordia dichotoma* G Forst. leaves, used to produce sterility among the tribal women through its abortificient activity. The extract was found to be safe up to dose of 2000 mg/kg body weight when administered orally. A good Antiimplantation (81.22%) activity in female rats was observed at the tested dose levels (200 and 400 mg/kg, orally). The extract further showed more significant (P0.01) increase in uterine weight and significant change in biochemical parameters in immature rats. Simultaneous administration of extract along with ethinyl estradiol showed significant estrogenic activity.	2015
29.	*Couroupita guianensis* Aubl.	*Lecythidaceae*	(15)	Bark and Flower	Water extracts of *Couroupita guianensis* bark and flower showed significant prolongation of dioestrus stage ($p<0.05$). Ethanol extract of *Couroupita guianensis* bark and all the extracts of its flower reduced the number of implantations.	2005
30.	*Crataeva nurvala* Buch Ham	*Capparidaceae*	(34)	Stem bark	The ethanol and aqueous extracts of the dried stem bark of the plant *Crataeva nurvala* Buch-Hum have been found to possess significant anti-fertility effects in rats. Both ethanol and aqueous extracts exhibited partial and complete resorption of implants at 300 and 600 mg/kg body weight dose levels, respectively. In estrogenic activity study, both the extracts increased uterine weight and caused opening and cornification of vagina in immature rats.	2009
31.	*Crotalaria juncea* L.	*Leguminosae*	(35)	Seed	The various extracts of *C. juncea* seeds arrest spermatogenesis and are likely to have an antiandrogenic activity.	2004
32.	*Curcuma longa* L.	*Zingiberaceae*	(36)	Rhizome	Aqueous and ethanolic extract of rhizome of *Curcuma longa was* administered orally to female rat for 30 consecutive days. It showed significant Antifertility activity. FSH and LH level was significantly decreased in both drugs while	2011

					amount of estrogen in ethanolic extract was found to be increased.	
33.	*Dactyloctenium aegyptium* (L.) Willd.	*Poaceae*	(37)	Whole plant	Ethanolic extract of *D. aegyptium* extract at a dose of 200, 400, and 600 mg/kg body weight were administered, respectively for a period of 30 days. A non-significant increase in the bodyweight and a significant decrease in weight of testes, accessory sex organs, and reduction in sperm count, increase motility and abnormality were observed. Some serum biochemical parameters showed significant variations and were as the serum hormonal levels are significantly decreased.	2016
34.	*Dendrophthoe falcata* (L.f.) Ettingsh.	*Loranthaceae*	(38)	Aerial Parts	In postcoital testing, the extract was found to be more effective in causing significant anti-implantation activity and reduction in the number of litters born.	2009
35.	*Derris brevipes* (Benth.) Baker	*Leguminosae*	(39)	Root	The combined antifertility (anti-implantation and abortifacient) activity of the ethanolic extract was 100%. The results suggest that the ethanolic extract possesses more abortifacient type effect than the anti-implantation activity.	2003
36.	*Dodonaea viscosa* (L.) Jacq.	*Sapindaceae*	(40)	Leaves	The methanolic extract of the leaves of this plant was investigated for their anti-fertility activity in female rats. The identification of the secondary metabolites showed that the leaves of the plant contained alkaloids, phytosterols and polyphenols. It was found that the extract reduced significantly ($p<0.01$) the number of liters and administered through oral route. It also produced ant fertility effect in a dose dependent manner and the contraceptive effect was manifested for a definite period of time	2011
37.	*Drynaria quercifolia* (L.) J. Sm.	*Polypodiaceae*	(41)	Rhizome	Methanolic extract of *Drynaria quercifolia* (L.) J. Smith rhizome has been proved to have significant anti-fertility activity.	2014
38.	*Embelia ribes* Burm.f.	*Primulaceae*	(42)	Fruit	Embelin, extracted from *Embelia ribes* Burm. berries, altered the testicular histology and glycogen, gametogenic counts and accessory sex gland fructose at the dose levels 0.3,0.4 and 0.5 mg/kg body weight administered subcutaneously for 35 days. The compound is suggested to possess antiandrogenic activity.	1986
39.	*Ficus racemosa* L.	*Moraceae*	(43)	Bark	Swiss male mice were orally administered hydroalcoholic extract of *Ficus racemosa* bark (50 mg/kg for 30 d and 100 mg/kg body weight for next 30 d), and the effect of the treatment on body weight, reproductive organs weight, sperm, biochemical profile (sialic acid in epididymis and fructose in seminal vesicle), fertility and vaginal contraceptive efficacy was investigated. Extract reduced fertility to 70% within 60 d. Suppression of cauda epididymis sperm count, motility, viability and abnormal morphology was observed. Marked reduction was noted in the weight of reproductive organs and the level of sialic acid in epididymis and fructose in seminal vesicle. Vaginal application of bark extract exhibited 80% vaginal contraceptive efficacy. After cessation of plant	2011

					extract treatment, the altered parameters recovered after 60 days.	
40.	*Hibiscus rosa-sinensis* L.	*Malvaceae*	(44)	Flower	Extracts from the flowers of the plant were 100% effective in preventing pregnancy.	1977
			(45)	Flower	Pregnant female mice were dosed with extract (100 mg/kg body weight) from days 1 to 6 of pregnancy. No implantation sites were observed in treated animals when they were surgically opened on day 15 of pregnancy.	2005
41.	*Hymenocardia acida* Tul.	*Phyllanthaceae*	(46)	Stem bark	The results suggest that aqueous ethanolic extract of *Hymenocardia acida* stem bark could induce negative effects on reproductive functions in female albino rats.	2011
42.	*Jatropha gossypiifolia* L.	*Euphorbiaceae*	(47)	Leaf	*Jatropha gossypifolia* leaf extract, when administered orally, altered the estrous cycle pattern in female mice, prolong the length of estrous cycle with significant increase in the duration of diestrus stage and reduced significantly the number of litters in albino mice. Treatment of mice with extract of 250 and 450 mg/kg body weight/day for 21 days caused a prolonged estrous cycle with significant increase in the duration of diestrus phase and elongation of estrus stage in treatment with higher dose (450 mg/kg body weight/day)	2012
43.	*Juniperus communis* L.	*Cupressaceae*	(48)	Fruits	Extract of *Juniperus communis* fruits in 50 % ethanol has been screened for anti-fertility activity in Swiss albino female rats. 300 mg and 500 mg of the drug per kg body weight of the rat were administered orally from day 1 to 7 of pregnancy. Laparotomy on 10th day revealed an antiimplantation activity which was found to depend upon the dose of the drug. The drug was also found to possess abortifacient activity at both the dose levels when administered on days 14, 15 and 16 of pregnancy.	1980
44.	*Lithospermum ruderale* Douglas ex Lehm.	*Boraginaceae*	(49)	Root	It has been shown that *Lithospermum ruderale* has an anti-oestrous effect on rats, the roots containing more active material than the tops. The subcutaneous injection of extracts of the plant is at least 10 times more effective than oral administration.	1950
			(50)	Root	Female mice of C_3H strain when fed on a diet of 15% *Lithospermum ruderale* go into an immediate and persistent anestrus. Female mice of Rockland strain fed similarly also go into anestrus which, however, may be followed by varying degrees of developed refractoriness to the drug, as evidenced in some mice by a reappearance of normal estrous cycles. The anestrous condition in both strains is accompanied by atrophy of the ovaries and uteri, and atresia of the follicles.	1946
45.	*Marsilea minuta* L.	*Marsileaceae*	(51)	Whole Plant	The methanol extract produced antifertility activity in mice, which may be due to inhibition of gonadal steroido genesis.	2002
46.	*Martynia annua* L.	*Martyniaceae*	(52)	Root	A dose related reduction in the testicular sperm count, epididymal sperm count and motility, number of fertile males, ratio between delivered and inseminated females and number of pups were observed.	2002

47.	*Michelia champaca* var. *champaca*	*Magnoliaceae*	(53)	Leaves	Hydroalchoholic extract of *Michelia champaca* leaves possesses significant antifertility effect which might be due to the inhibition of implantation and estrogenic effect which in turn might be due to the presence of some phytoconstituents in the plant.	2013
48.	*Momordica charantia* L.	*Cucurbitaceae*	(54)	Seeds	Petroleum ether, benzene and alcohol extracts of the seeds of *Momordica charantia* tested in rats at the dose level of 25 mg/100 g body weight for 35 days showed antispermatogenic activity as the number of spermatocytes, spermatids and spermatozoa was decreased. Increase in cholesterol level and Sudanophilic lipid accumulation indicates inhibition in the steroidogenesis. At the same time the weight of epididymis, prostate gland, seminal vesicle and levator ani was increased which showed its androgenic property.	1998
49.	*Mondia whitei* (Hook.f.) Skeels	*Apocynaceae*	(55)	Root Bark	Chronic administration of *Mondia whitei* root bark extract (400 mg/kg/day) for 55 days caused testicular lesions resulting in the cessation of spermatogenesis, degenerative changes in the seminiferous tubules and epididymides.	2001
50.	*Murraya paniculata* (L.) Jack	*Rutaceae*	(56)	Roots	Yuehchukene, 11β-(3′-indolyl-7,9α,9β-trimethyl-5β,8,9,10β-tetrahydroindano-[2,3-*b*]indole, a novel dimeric indole alkaloid from the roots of *Murray a paniculata* has potent anti-implantation activity in rats at 3 mg/kg *p. o*. dosing on pregnancy day 2.	1985
51.	*Nelumbo nucifera* Gaertn.	*Nelumbonaceae*	(57)	Seeds	It may be concluded that the ethanolic extract of *Nelumbo nucifera* seeds has antiestrogenic effect in female rats.	2008
52.	*Nigella sativa* L.	*Ranunculaceae*	(58)	Seeds	Hexane extract of the seeds of *Nigella saliva* L. prevented pregnancy in Sprague-Dawley rats treated orally at 2 g/kg daily dose on days 1-10 post-coitus. Significant antifertility activity was also observed in its column fractions and sub fractions.	1995
53.	*Ocimum gratissimum* L.	*Lamiaceae*	(59)	leaves	The study reveals that the aqueous leaf extract of *O. gratissimum* has anti-fertility property when administered alone	2010
54.	*Ocimum tenuiflorum* L.	*Lamiaceae*	(60)	Leaves	Treatment of albino rats with a benzene extract of *Ocimum sanctum* leaves (250 mg/kg body weight) for 48 d decreased total sperm count, sperm motility, and forward velocity.	2002
			(61)	Leaves	Fresh leaves of *Ocimum Sanctum* (OS) were used to study its effect on male reproductive function (sperm count and reproductive hormones) in male albino rabbits. Animals in the test group received supplementation of 2 g of fresh leaves of OS per rabbit for 30 days, while the control group was maintained on normal diet for the same duration. Sperm count and hormonal estimation [testosterone, follicle stimulating hormone (FSH), and luteinizing hormone (LH)] were done in serum samples of both groups and compared. A significant decrease was noted in the sperm count in test group rabbits. Serum testosterone levels showed marked increase while FSH and LH levels were significantly reduced in OS-treated	2010

					rabbits. The results suggest the potential use of OS as an effective male contraceptive agent.	
55.	*Physalis alkekengi* L.	*Solanaceae*	(62)	Fruit	The results of the present study showed that administration of *P. alkekengi* demonstrates antiimplantation activity	2007
56.	*Piper betle* L.	*Piperaceae*	(63)	Petiole	*P. betle* ethanolic extract exerted antifertility and antiestrogenic effects in female rats.	2007
57.	*Piper longum* L.	*Piperaceae*	(64)	Fruits	The antifertility activity of piperine was investigated in pregnant mice when given by various routes of administration and at different periods of gestation. Piperine effectively inhibited implantation, produced abortion and delayed labor when it was given from day 2 through 5, day 8 through 12 and day 15 until labor, respectively.	1982
58.	*Pisum sativum* L.	*Leguminosae*	(65)	Seed Oil	As a result of several trials on 13 human subjects, of whom 4 became pregnant, it was concluded that the oil of *Pisum sativum*, L. when injected is an effective contraceptive. In the successful subjects 0.5 ml. of the oil given monthly between the approximate time of ovulation and menstruation was sufficient to prevent conception. It is suggested that for unsuccessful subjects the quantity given should be the maximum which can be administered without damage to the tissues. In a fourteenth subject who was pregnant the oil caused abortion.	1951
59.	*Plumbago indica* L.	*Plumbaginaceae*	(66)	Leaves	The acetone and ethanolic extracts of *P. rosea* leaves have an antifertility activity.	2009
60.	*Pueraria tuberosa* (Willd.) DC.	*Leguminosae*	(67)	Root	Oral administration of *Pueraria tuberosa*. D.C. root extract to male rats (100 mg/rat per day) for the period of 60 days did not cause body weight loss, whereas the weights of testes, epididymides, seminal vesicle, and ventral prostate were significantly reduced. The production of step-19 spermatids was reduced by 63.7% in *P. tuberosa*.–treated rats. The population of preleptotene spermatocytes and secondary spermatocytes were decreased by 61 and 72%, respectively. The seminiferous and Leydig cell nuclear area were reduced significantly ($p < 0.001$) when compared to controls. The number of mature Leydig cells was significantly reduced. Treated rats showed significant ($p < 0.001$) reduction in the sperm concentration of testes and cauda epididymides. The sperm motility of the cauda epididymides was also reduced significantly ($p < 0.001$). The *Pueraria* treatment reduced the fertility of male rats by 100%. A significant fall in the total protein and sialic acid contents of the testes, epididymides, seminal vesicle, and ventral prostate as well as glycogen contents of testes was also observed.	2005
61.	*Quassia amara* L.	*Simaroubaceae*	(68)	Stem	The crude methanol extract of the stem wood of *Quassia amara* L. inhibited both the basal and LH-stimulated testosterone secretion of rat Leydig cells in a dose-dependent fashion. Fractionation of the extract by chromatography gave quassin (1) and 2-methoxycanthin-6-one (2); compound 1 proved to be the bioactive	1995

					agent.	
62.	*Raphanus raphanistrum* subsp. *sati vus* (L.) Domin	*Brassicaceae*	(69)	Root Juice	The results obtained from the present study have shown that *Raphanus sativus* possess antifertility activity. In female rats *Raphanus sativus* disturbed the estrous cycle along with increase in cholesterol & protein content and decreased the G6PD level. *Raphanus sativus* was found to decrease the number of implantation, average number of pups delivered, average weight of the pups, number of corpora lutea, and weight of ovary.	2011
63.	*Ricinus communis* L.	*Euphorbiaceae*	(70)	Whole plant	The antifertility effects of 50% ethanol extracts of *Ricinus communis* have been studied in male rats. There was a drastic reduction in the epididymal sperm counts. Alteration in the motility, mode of movement and morphology of the sperms were observed. Reductions in the fructose and testosterone levels were suggestive of reduced reproductive performance. Reversibility tests showed that the antifertility effect of *Ricinus communis* was completely reversible on withdrawal of the drug.	2003
64.	*Rumex steudelii* Hochst. ex A. Rich.	*Polygonaceae*	(71)	Whole plant	All these observations suggest that the extract has antifertility effect and is safe at the effective antifertility doses	2005
			(72)	Whole plant	All these observations suggest that the extract produced antifertility effect mainly by inhibiting implantation though antiestrogen, progesterogen and uterotonic effects could as well be possible mechanisms.	2005
65.	*Ruta graveolens* L.	*Rutaceae*	(73)	Root and aerial parts	Different preparations of *Ruta graveolens* were administered orally to female rats (Days 1–10 post coition) and female hamsters (Days 1–6 post coition). The powdered root, aerial parts and the aerial parts aqueous extract all showed potential anticonceptive activity in rats.	1991
66.	*Solanum virginianum* L.	*Solanaceae*	(74)	Seed	The genital organ weight of albino rats was reduced significantly ($P<0.05$) after the treatment at 100 and 150 mg/kg doses of seed powder of *S. xanthocarpum* for 30 days. The higher doses caused histopathological changes in the ovary and uterus leading to 100% control of fertility as no implants was recorded in treated female rats on the day 10th of pregnancy.	2013
67.	*Spondias mombin* L.	*Anacardiaceae*	(75)	Leaves	Aqueous ethanol leaf extract of *S. mombin* has significant anticonceptive activity attributed to a direct action of the extract on the uterus.	2008
68.	*Striga asiatica* (L.) Kuntze	*Orobanchaceae*	(76)	Whole plants	Graded doses of these compounds, in gum acacia suspension, by oral administration from day 1 to day 4 of pregnancy showed dose-dependent antiimplantation activity (5–25 mg/kg body weight/day). MED_{100} was found to be 25 mg/kg body weight in the day 1–4 regimen in rats for both the compounds. In another study, a single oral dose of these compounds (10 mg/kg body weight) on day 1, 2 or 3 of pregnancy prevented 100% implantation.	1990

69.	*Striga densiflora* (Benth.) Benth.	*Orobanchaceae*	(77)	Whole plants	The ethanol and petroleum ether (60–80°C) extracts of *S. densiflora* were administered orally to pregnant albino rats for 7 days at the dose of 10 and 20 mg/100 g body weight and showed significant antifertility and estrogenic activity. The antifertility activity was reversible on withdrawal of the plant extract treatment.	1996
70.	*Strychnos potatorum* L.f.	*Loganiaceae*	(78)	Seed	*Strychnos potatorum* is capable to suppress male fertility without altering general metabolism	2006
71.	*Terminalia chebula* Retz.	*Combretaceae*	(79)	Fruit	The results of present experiment suggested that the aqueous-ethanolic (1:1) extract of fruit of *T. chebula* exerted a significant anti-spermatogenic effect in male rat.	2015
72.	*Tinospora sinensis* (Lour.) Merr.	*Menispermaceae*	(80)	Stem	Ethanol extract of *Tinospora cordifolia* stem possible exert a reversible antifertility effect mediated through testes and/or epididymis, without any adverse toxicological effects.	2011
73.	*Trachyspermum ammi* (L.) Sprague	*Apiaceae*	(81)	Fruit	The alcoholic extract dose dependently produces the male anti-fertility by reduction in testes weight, number of sperms, sperm motility, but increased the production of abnormal sperms and altering the cellular pattern of testes. However the drug on withdrawal, the reproductive system reverts back to normal conditions by restoring the testes weight, sperm motility.	2011
74.	*Tragia involucrata* L.	*Euphorbiaceae*	(82)	Aerial Parts of plant	Observations suggest that extracts have antiimplantation as well as the abortifacient activity and are safe at the effective antifertility doses employed in this study.	2011
75.	*Trigonella foenum-graecum* L.	*Leguminosae*	(83)	Seeds	On the basis of these observations it may be concluded that ethanolic extract of TFG owing to its estrogenic nature alters the biochemical milieu of the uterus which lead to a change in the normal status of reproduction in female reproductive tract of rats and thus produce significant antifertility activity.	2010

DISCUSSION AND CONCLUSION

Herbal medicines and their derivatives are being used since ages. Globally, It is presumed such herbal based products cause fewer side effects than modern medicines. So in recent times, the extensive use of medicinal plants is beginning to gain global reputation. Because of this, the global herbal medicine sector is getting bigger day by day. Currently, it is believed that approximately 75% of the population in developing nations receives herbal medical health care, compared with over half of the population in developed nations, particularly for lifestyle-related diseases. So, our Mother Nature which has been a source of medicines for thousands of years and an impressive number of modern drugs has been isolated from natural sources, many antifertility drugs are there to be known. Medicinal plants have a proven efficacy as antifertility agents. The mechanism of action of many herbs has been identified and for many others, it is yet to be identified. Further extensive research is required to better ascertain the bioactivity of their compounds to find out their activity as antifertility agents so that new and efficacious drugs can be developed. Lack of quality control, Toxicological studies and compliance with international regulatory standard are the main challenges of medicinal antifertility plants.

In conclusion, the aim of this review is to document medicinal antifertility plants that have been documented since last seven and half decades. There is a wide scope of finding out new and efficacious drugs as antifertility agents. But further extensive experimental studies are required to better ascertain their activity as antifertility agents. Also, the mechanisms of action by which plant extracts and their active compounds exert antifertility effects remain to be studied. We hope this article may help other researchers and investigators to identify medicinal plants responsible for anti-fertility activity in near future which could be of great scientific contribution to the society.

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest related to the subject matter or materials discussed in this article.

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