Role of Anti-fertility Medicinal Plants on Male & Female Reproduction

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Authors’ contributions
This work was carried out in collaboration between all authors. Author AS designed the study, collected required literature, wrote the protocol and wrote the first draft of the manuscript. Author PRY helped in literature searches and designing final draft copy of manuscript and author CKB managed for the final outcome of manuscript without grammatical errors. All authors read and approved the final manuscript.

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ABSTRACT

Aim and Objective: The aim of this review was to provide a detailed concept to the researchers on antifertility activity of several plants inhibiting male and female fertility and may be developed into contraceptives. Despite of many medicinal plants have been claimed to prevent fertility, only few plants were so far been investigated for their antifertility activity.

Materials and Methods: An extensive bibliographic investigation was carried out by analyzing various classical text books, scientific journals, consulting worldwide accepted databases for

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providing suitable information on antifertility medicinal plants. Plant species traditionally used as contraceptives, abortifacients, emmenagogues, spermatogenics were considered as antifertility agents.

**Results:** Overall 233 plant species belonging to various families, traditionally used as antifertility agents in both males and females has been incorporated in this review. The various plant parts used in fertility regulation includes leaves, fruits, roots, bark, stem etc.

**Conclusion:** In conclusion, it is clear that medicinal plants play an important role as antifertility agents. Despite of various commercially available oral contraceptives in the market, herbal antifertility agents shows promising output by minimizing the number of adverse drug properties. Current research towards traditional medicine is growing rapidly because of its safety and less cost consumption.

**Keywords:** Antifertility; plant extracts; contraceptive; abortifacient; fertility regulation.

1. **INTRODUCTION**

Antifertility agents are those which are capable of preventing ovulation or fertilization and able to induce termination of pregnancy [1]. Overpopulation is becoming one of the global problems causing much influence on economic, social and natural resources [2]. The increase in population is alarming the developing world in the need for effective birth control measures [3]. One of the serious problems in the developing countries like India is over population and which would be increased about 9.2 billion by the year 2050 [4].

Although a several synthetic contraceptive agents are available today, their use is associated with severe side effects, such as hormonal imbalance, hypertension, increased risk of cancer and weight gain [5]. Hence people are looking forward to the tradition of using herbal medicines, which have minimum and less side effects [6].

Medicinal plants are been using form many centuries to treat both mental and physical illness and to improve health of individuals, and approximately 80% of medical treatments are practicing by the developing countries [7]. However in the recent past much interest has been shown to control regulation of fertility by using medicinal plants [8]. Fertility regulation comprising contraception and management of infertility forms an important component of reproductive health [9].

Several plant extracts inhibit male and female fertility and may be developed into contraceptives. Despite of many medicinal plants have been claimed to prevent fertility, only few plants were so far been investigated for their antifertility activity. Moreover the World Health Organization (WHO) has set up a task force on plant research to find out new orally active non-steroidal contraceptive compounds [10].

1.1 **Mechanism of Action of Antifertility Plants**

Medicinal plants have been reported to possess antifertility effects by various mechanism of actions, one of the major action is their effect on sex hormones particularly for suppressing fertility, regularizing menstrual cycle, relieving dysmenorrhea, treating enlarged prostate, menopausal symptoms, breast pain etc.; [11].

More over plants with estrogenic property can directly influence pituitary action by peripheral modulation of luteinizing hormone (LH) and follicle stimulating hormone (FSH), decreasing their secretions and blocking ovulation [12]. The plants with anti-estrogenic activities intercept in the process of development of ovum and endometrium and on the other hand, plants have abortifacient effects [13,14].

The site of action of antifertility agents in females, comprises of the hypothalamus, the anterior pituitary, the ovary, the oviduct, the uterus and the vagina. The mammalian uterus is the main site of antifertility effects [11]. Typical estrogenic compounds possess ability to increase the uterine wet weigh and induce cornification and opening of vagina in immature rats which results anti-implantation effects [15].
Plant extracts are also shown promising antifertility effects when administered to male rats. The various effects on male reproductive system to induce antifertility action shown by plants includes antispermatogenic effect, post-testicular antifertility effect, spermicidal, sperm immobilizing effect, antiandrogenic effect etc...

Therefore, aim of the present study has been made to review antifertility activity of selected medicinal plants which have been used as herbal contraceptives.

2. MATERIALS AND METHODS

The information provided in this review, was a result of an extensive bibliographic investigation by analyzing classical text books, scientific journals, consulting worldwide accepted databases. The peer reviewed papers were gathered from different databases like SCOPUS, PUBMED, Google Scholar, INFLIBNET etc. over all 233 plants were reviewed for their antifertility effects along with their possible mechanism of actions, part used, family and animal used.

This reviw was concentrated to incorporate list of various plants, that have been mentioned for their use as antifertility agents in traditional medicinal, and along with that it also contains plant extracts, those which are already proved by various scientific papers.

3. RESULTS

More than 300 scientific peer reviewed articles were investigated for searching the traditional/folk-lore use of plants possessing antifertility activity. The various plants claimed and proved as antifertility, abortifacient, contraceptive, spermicidal, emmenagogue etc were included.

Following is the list of plants reported to possess antifertility effects along with their parts used and mechanism of actions.

4. DISCUSSION

Medicinal plants, since ancient times have a long history of traditional use in all parts of world. In India as well as other parts in the world there are several medicinal plants which are reported to possess antifertility properties [224]. There are several plants reported by the medical historians that can possess abortifacient, contraceptive and emmenagogue properties [154].

The objective of this review is to present a detailed and analyzed ethnopharmacological data of 233 plant species for regulating fertilization and conception which are being used by the various tribes all over the world during last few decades. The names of the plants including their family, part used, animal used and mechanism of action were included in the table. As shown in the table the plants were catagorised according to their effects as antifertility agents, abortifacients, contraceptives, emmenagogues and sterilizers, and some plants which have multiple properties depending upon the dose are also included. Moreover, this review contains list of plants having their effective role in regulating fertility control in both male and females. During the literature survey it was observed that among the various parts of plants, leaves have been extensively used for controlling fertilization. The other plant parts includes stems, bark, roots, seeds, flowers, gums etc were used in small proportions.

The various medicinal plants cited such as *Abroma angusta* [16], *Acalypha indica* [23], *Allium sativum* [36], *Artemisia vulgaris* [1], *Bacopa monnieri* [43], *Butea monosperma* [52], *Calotropis procera* [53], *Daucus Carota* [84], *Embelia Ribes* [95], *Epilobium angustifolium* [96], *Ficus religosa* [104], *Franseria artemisiodes* [111], *Galium mexicanum* [112], *Gardenia jasminoides* [114], *Hamelia erecta* [121], *Hibiscus rosa-sinensis* [123], *Jasminum multiflorus* [129], *Lawsonia inermis* [136], *Lepidium sativum* [139], *Myristica fragrans* [152], *Nardostachys jatamansi* [154], *Nicotiana tabacum* [156], *Ocimum sanctum* [159], *Papaver somniferum* [33], *Piper longum* [167], *Ruta graveolens* [182], *Santalum album* [185], *Terminalia arjuna* [197], *Trigonella foenumgraecum* [200], *Urginea indica* [206], *Vernonia amygdalina* [211], *Withania somnifera* [218], *Zinziber officinale* [33], *Ziziphus nummularia* [221] confirmed potent antifertility effects.
Table 1. List of medicinal plants reported to possess antifertility effects

| S. no. | Name of the plant          | Family          | Part used | Animal model | Mechanism of action                                  | Reference       |
|--------|-----------------------------|-----------------|-----------|--------------|------------------------------------------------------|-----------------|
| 1.     | Abroma angusta Linn.        | Sterculiaceae   | Roots     | Rat          | Antiimplantation & Abortifacient                      | [16, 17]        |
| 2.     | Abrus precatorius Linn.     | Fabaceae        | Seeds     | Rat          | Reduced sperm motility, Post-testicular antifertility effect | [18, 19]        |
| 3.     | Acacia auriculaeformis A. Cunn. | Fabaceae    | -         | -            | Sperm immobilizing effect                             | [20]            |
| 4.     | Acacia caesia Wight & Arn   | Leguminosae     | Fruit     | -            | Immobilization of spermatzoa                          | [21]            |
| 5.     | Acacia concinna DC          | Fabaceae        | Stem bark | Rat          | Spermicidal and semen coagulating activities          | [22]            |
| 6.     | Acalypha indica Linn.       | Euphorbiaceae   | Whole plant | -            | Anti-estrogenic activity                              | [23, 24]        |
| 7.     | Achillea millefolium Linn.  | Asteraceae      | Flowers   | Mice         | Antispermatogenic effect                              | [25]            |
| 8.     | Achyranthas aspera Linn.    | Amranthaceae    | Root      | Rat          | Spermicidal action                                   | [26]            |
| 9.     | Actiniopteris dichotoma Kuhn| Pteridaceae     | Whole plant | Rat          | Antifertility effect                                  | [27]            |
| 10.    | Adhatoda vasica Nees Syn.   | Acanthaceae     | Leaves    | Rat          | Antifertility activity                                | [16, 24]        |
| 11.    | Aegle marmelos Corr. Ex Roxb. | Rutaceae      | Leaf      | Rat          | Resist process of spermatogenesis and decrease sperm motility | [28, 29]        |
| 12.    | Aerva lanata (L.) Juss. Ex Shult | Amaranthaceae | Aerial parts | Rat          | Antifertility effect                                  | [30]            |
| 13.    | Afromosia laxiflora (Baker) Harms | Fabaceae   | Stem bark | Rat          | Antigonadotropic activity and blocks oestrous cycle   | [31]            |
| 14.    | Ailanthus excelsa Roxb.     | Simaroubaceae   | Leaf, Stem, Bark | Rat          | Antiimplantation effect and Early Abortifacient       | [32]            |
| 15.    | Alangium Salvifolium (L.f.) | Angiaceae       | Stem, Bark | Rat          | Antiimplantation & Abortifacient                      | [33]            |
| 16.    | Albizia procera (Roxb.) Benth. | Leguminosae | Seed and Root | Rat          | Spermicidal and semen coagulating activities          | [22]            |
| 17.    | Albizia lebbek (Linn.) Benth. | Mimosaceae     | Pod, Bark | Rat          | Antifertility activity                                | [34, 35]        |
| 18.    | Allium cepa Linn.           | Liliaceae       | Bulb      | Rat          | Antiimplantation activity                             | [16]            |
| 19.    | Allium sativum Linn.        | Amaryllidaceae  | Pod       | Rat          | Antispermatogenic activity                            | [36]            |
| 20.    | Aloe barbadensis Mill. Syn. | Liliaceae       | Leaves    | Dog          | Antiandrogenic activity                               | [37]            |
| 21.    | Alstonia scholaris R.Br.    | Apocynaceae     | Stem bark | Rat          | Antifertility activity                                | [38]            |
| 22.    | Amaranthus spinous Linn.     | Amaranthaceae   | Root      | Rat          | Inhibit fusion of Sperm and Ovum                      | [39]            |
| 23.    | Amaranthus viridis L.        | Amaranthaceae   | Root      | Rat          | Contraception Activity                                | [33]            |
| 24.    | Anacardium occidentale Linn. | Anacardiaceae   | Nut Shell | Rat          | Spermicidal                                            | [16]            |
| S. no. | Name of the plant                  | Family           | Part used                  | Animal model | Mechanism of action                                                                 | Reference |
|-------|-----------------------------------|------------------|----------------------------|--------------|------------------------------------------------------------------------------------|-----------|
| 25.   | Anagalis arvensis Linn.           | Primulaceae      | Whole Plant                | Rat          | Spermicidal and semen coagulating activities                                        | [22]      |
| 26.   | Ananas comosus Merr.              | Bromeliaceae     | Unripe fruit               | Rat          | Antispermatogenic activity                                                           | [40]      |
| 27.   | Andrographis paniculata Wall. Ex Nees | Acanthaceae   | Leaves                     | Rat          | Antispermatogenic and antiandrogenic activity                                         | [41]      |
| 28.   | Arctium lappa Linn.               | Asteraceae       | Leaves and roots           | Rat          | Abortifacient                                                                      | [33]      |
| 29.   | Ardisia solanacea Roxb.           | Myrsinacea       | Plants excluding roots     | Rat          | Spermicidal Activity                                                                | [16]      |
| 30.   | Aristolochia indica Linn.         | Aristolochiaceae | Root                       | Presbytes   | Antispermatogenic and antiandrogenic activity                                         | [42]      |
| 31.   | Artemisia afra Jacq. Ex Wild.     | Asteraceae       | Leaf                       | Rats         | Abortion                                                                           | [33]      |
| 32.   | Artemisia vulgaris Linn.          | Asteraceae       | Leaves                     | Rats         | Antiimplantation and Estrogenic activity                                             | [1]       |
| 33.   | Aspilia Africana (pers.) C.D. Adams | Acanthaceae | Leaves                     | Rats         | Antiovulatory Activity                                                             | [43]      |
| 34.   | Austroplenckia populnea (Reiss.) Lundell. | Celastraceae | Pods                       | Rats         | Affects the sexual behavior and epididymal sperm concentration                     | [44]      |
| 35.   | Azadirachta indica A. Juss.       | Malvaceae        | Seed Oil                   | Rats         | Antispermatogenic and antiandrogenic activity                                         | [45]      |
| 36.   | Bacopa monnieri (L.) Pennell       | Scrophulariaceae | Whole plant                | Rats         | Contraception Activity                                                             | [43]      |
| 37.   | Balanites roxburghii Linn.        | Zygophyllaceae   | Fruits                     | Dog          | Antispermatogenic activity and testicular necrosis and atrophy                     | [46, 47] |
| 38.   | Ballota undulate (Sieber ex. Fresen.) Benth. | Labiatae      | Leaves, Flowers            | Rats         | Antiimplantation activity                                                           | [43]      |
| 39.   | Bambusa arundinacea Wild.         | Gramineae        | Shoots, Stem               | Rats         | Impaired the structural and functional activity of epididymis, Reduced sperm motility | [48]      |
| 40.   | Barleria prioris Linn.            | Acanthaceae      | Roots                      | Rat          | Antifertility effect                                                               | [49]      |
| 41.   | Berberis chinapucta Buch.-Ham.ex Lindl. | Berberidaceae | Roots                      | Rat          | Antispermatogenic activity                                                          | [50]      |
| 42.   | Biophytum sensitivum (L.) DC.     | Oxalidaceae      | Leaves                     | Rats         | Antiimplantation Activity                                                           | [51]      |
| 43.   | Bougainvillea Comm. Ex Juss.      | Nyctaginaceae    | Leaves                     | Rats         | Antifertility effect                                                               | [51]      |
| 44.   | Butea monosperma (Lam.) Kuntze    | Fabaceae         | Seed                       | Rat, Dog     | Effects on testicular function                                                     | [52]      |
| 45.   | Calotropis procera (Ait.) R. Br.  | Asclepiadaceae   | Roots                      | Rabbit,      | Antispermatogenic effect anf leydig cell atrophy Functional alteration in the genital organs and inhibition of fertility | [53, 54] |
| S. no. | Name of the plant | Family               | Part used            | Animal model | Mechanism of action                                                                 | Reference |
|-------|-------------------|----------------------|----------------------|--------------|-------------------------------------------------------------------------------------|-----------|
| 46    | Cananga odorata (Lam.) Hook. F. & Thomson | Annonaceae           | Root, Bark           | Rat          | Spermicidal Activity                                                                 | [55]      |
| 47    | Cannabis sativa Linn. | Cannabaceae         | Leaves               | Presbytis Monkey | Testicular lesions and atrophy of Leydig cells                                      | [56]      |
| 48    | Cardiospermum Helicacabum L. | Spindaceae         | Whole plant          | Rat          | Antiimplantation activity                                                            | [51]      |
| 49    | Carica papaya Linn. | Caricaceae           | Fruit                | Rat          | Antispermatogenic activity                                                            | [57]      |
| 50    | Carum carvi Linn.  | Apiaceae             | Rhizome              | Rat          | Antioestrogenic activity                                                              | [43]      |
| 51    | Cassis fistula Linn. | Caesalpiniaeae      | Pods, Seeds          | Rat          | Antioestrogenic activity                                                              | [58]      |
| 52    | Catharanthus roseus G. Don syn. Vinca rosea Linn. | Apocynaceae        | Leaves               | Mice         | Antioestrogenic activity                                                              | [59]      |
| 53    | Celastrus paniculatus Wild. | Celastraceae       | Seeds                | Rat          | Antispermatogenic action                                                              | [60]      |
| 54    | Cicer arietinum Linn. | Fabaceae            | Seeds                | Rat          | Abortifacient and estrogenic activity                                                 | [61]      |
| 55    | Cichorium intybus Linn. | Asteraceae          | Whole plant          | Rat          | Antispermatogenic activity                                                            | [62]      |
| 56    | Cinnamomum Camphora Nees & Eberm. | Lauraceae           | Seed                 | Sparrow      | Arrest and inhibition of spermatogenesis                                             | [63]      |
| 57    | Cissampelos pareira Linn. | Menispermaceae     | Leaves               | Mice         | Antioestrogenic activity                                                              | [64]      |
| 58    | Citrullus colocynthis Schrad. | Cucurbitaceae    | Fruit, Root          | Rat          | Induced reversible antifertility effects and Antispermatogenic effect                 | [65, 66] |
| 59    | Clerodendrum serratum L. | Lamiaceae/Verbenaceae | Whole plant (Excluding Roots) | Rats         | Spermicidal activity                                                                 | [67]      |
| 60    | Cnidoscolous aconitifolius (Mill.)I.M.Johnst. | Euphorbiaceae | Leaves               | Rats         | Contraception                                                                        | [68]      |
| 61    | Cola nitida Schott & Endl. | Sterculiaceae      | Stem Bark            | Rats         | Antigonadotropic activity and                                                         | [69]      |
| 62    | Colebrookia oppositifolia Sm. | Lamiaceae         | Leaf                 | Rats         | Antifertility Effect                                                                  | [70]      |
| 63    | Combretodendron macrocarpum (P.Beauv.) Keay | Barringtoniaceae | Stem bark            | Rats         | Antigonadotropic activity and                                                         | [71]      |
| 64    | Convolvulus microphyllus Sieb. ex Spreng | Convolvulaceae | Whole Plant          | Rats         | Antispermatogenic effect                                                              | [72]      |
| 65    | Crataeva nurvala Buch.Ham. | Capparidaceae      | Stem Bark            | Rats         | Antiimplantation and Antiestrogenic activity                                          | [73]      |
| 66    | Crotaflaria juncea Linn. | Papilionaceae       | Seeds                | Mice         | Antifertility Activity, Arrest of spermatogenesis and antiandrogenic Effect          | [74, 75] |
| 67    | Croton roxburghii Balak. | Euphorbiaceae      | Bark                 | Mouse        | Anti-steroidogenic activity                                                           | [76]      |
| 68    | Cumfitiga racemos L. | Apocyanaceae        | Root                 | Rats         | Spermatogenesis                                                                       | [77]      |
| 69    | Cuminum cyminum Linn. | Apiaceae            | Seed                 | Rats         | Antispermatogenic effect                                                              | [78]      |
| S. no. | Name of the plant                          | Family               | Part used | Animal model | Mechanism of action                                                                 | Reference |
|-------|--------------------------------------------|----------------------|-----------|--------------|------------------------------------------------------------------------------------|-----------|
| 70.   | Curcuma aromatica Salisb.                  | Zingiberaceae        | Rhizome   | Rats         | Antifertility Activity                                                              | [79]      |
| 71.   | Curcuma longa Linn.                        | Zingiberaceae        | Root      | Rats         | Interference with Spermatogenesis                                                   | [80]      |
| 72.   | Cyclamen persicum Mill.                    | Primulaceae          | Whole Plant| -            | Spermidical activity                                                               | [81]      |
| 73.   | Cyclia burmanni Miers                      | Menispermaceae       | Roots     | Rat          | Decrease Sperm Count                                                                | [82]      |
| 74.   | Cynomorum coccineum Linn.                  | Cynomoraceae         | Inner pulp of stem and root | Rats | Effect on epididymal sperm pattern                                                 | [83]      |
| 75.   | Dauca Carota Linn.                         | Apiaceae             | Seeds     | Rat          | Blastocystotoxic and Antiimplantaion effects; Postcoital contraceptive effects     | [84, 85] |
| 76.   | Dendrophthoe falcate (Linn. f.)            | Loranthaceae         | Aerial parts | Rats | Antifertility effect                                                               | [86]      |
| 77.   | Dess brevipes Baker.                       | Fabaceae             | Root Powder | Rats | Abortifacient                                                                      | [87]      |
| 78.   | Desmodium gangeticum DC.                   | Fabaceae             | Whole plant | Rat | Antifertility effect                                                               | [88]      |
| 79.   | Dioscorrea bulbilera L.                    | Dioscoreaceae        | Tuber     | -            | Contraceptive                                                                      | [89]      |
| 80.   | Diplocisya echinatus Linn.                 | Asteraceae           | Stem      | -            | Spermidical                                                                        | [90]      |
| 81.   | Dipsacu mitis D.Don                       | Spindaceae           | Root      | Hamster     | Contraceptive                                                                      | [91]      |
| 82.   | Ecballium elaterium A. Rich.               | Cucurbitaceae        | -         | Rabbit      | Decreases sperm motility                                                           | [92]      |
| 83.   | Echeveria gibbiflora DC                    | Crassulaceae         | Whole plant | Guinea Pig | Decreased sperm motility                                                           | [93]      |
| 84.   | Echinoes echinatus Ruxb.                   | Asteraceae           | Root      | Rat          | Sperm antimotility                                                                | [94]      |
| 85.   | Embelia Ribes Burt.f.                      | Myrsinaceae          | Berry     | Rat          | Antifertility activity                                                              | [95]      |
| 86.   | Epilobium angustifolium Linn.              | Onagraraceae         | -         | Rat          | Reduction in weight of accessory sex organs                                          | [96]      |
| 87.   | Eupatorium odoratum Linn.                  | Asteraceae           | -         | -            | Spermidical                                                                        | [97]      |
| 88.   | Euphorbia neriifolia Linn.                 | Euphorbiaceae        | Root      | Rat          | Antispermatogenic effects                                                          | [98]      |
| 89.   | Eugenia jambolana L.                       | Myrtaceae            | Flowers   | Rat          | Antifertility effect                                                               | [99]      |
| 90.   | Ehretia cymosa Thonn.                      | Boraginaceae         | Leaf, Bark | -            | Contraceptive                                                                      | [100]     |
| 91.   | Eleutherine bulbosa Urb.                   | Iridaceae            | Bulb      | Rat          | Abortifacient                                                                      | [101]     |
| 92.   | Fevila passiflora Vell.                    | Cucurbitaceae        | Seed      | -            | Abortifacient                                                                      | [102]     |
| 93.   | Ferula asa-foetida Linn.                   | Apiaceae             | Resin     | -            | Emmenagogue                                                                        | [103]     |
| 94.   | Ficus religosa Linn.                       | Moraceae             | Fruit     | Goat         | Anti-implantation                                                                  | [104]     |
| 95.   | Ficus wassa Roxb.                          | Moraceae             | Root      | -            | Contraceptive                                                                      | [105]     |
| 96.   | Flagellaria indica Linn.                   | Flagellariaceae      | Leaf      | -            | Contraceptive                                                                      | [106]     |
| 97.   | Flemingia strobilfera (L.) J. St. Hil syn, Moghania strobilfera (L.) J. St.-Hill. | Fabaceae             | Seed      | -            | Contraceptive                                                                      | [107]     |
| 98.   | Fleura aestuans Linn.                      | Utricaceae           | Root      | -            | Abortifacient                                                                      | [108]     |
| S. no. | Name of the plant | Family | Part used | Animal model | Mechanism of action | Reference |
|--------|-------------------|--------|-----------|--------------|--------------------|------------|
| 99.    | *Foeniculum vulgare* Mill. | Apiaceae | Seed      | Rat          | Sperm toxic        | [109]      |
| 100.   | *Fragaria vesca* Linn. | Rosaceae | Leaf      | -            | -                  | [110]      |
| 101.   | *Franseria artemisioides* Willd. | Asteraceae | Whole plant | -            | Contraceptive      | [111]      |
| 102.   | *Galium mexicanum* Var. | Rubiaceae | Leaves    | Cat          | Abortifacient      | [112]      |
| 103.   | *Garcinia cambogia* Desr. | Clusiaceae | Fruit     | Rat          | Testicular atrophy | [113]      |
| 104.   | *Gardenia jasminoides* Ellis. | Rubiaceae | Fruits    | -            | Abortifacient      | [114]      |
| 105.   | *Gloriosa superb* Linn. | Liliaceae | Roots     | Rat, mice    | Oxytocic activity, Abortifacient | [115] |
| 106.   | *Glossocarida bosvallia* DC. | Asteraceae | Whole plant | -            | Emmenagogue        | [116]      |
| 107.   | *Glycyrrhiza glabra* Linn. | Fabaceae | Root      | -            | Emmenagogue        | [117]      |
| 108.   | *Gossypium barbadense* Linn. | Malvaceae | Cotton Seed | rat         | Testicular         | [118]      |
| 109.   | *Grewia columnaris* Sm. | Trilliaceae | Root      | -            | Sterilizer         | [119]      |
| 110.   | *Hagenia abyssinica* *syn.* Brayera anthalmintica | Rosaceae | -         | -            | Abortifacient      | [116]      |
| 111.   | *Haematoxylon campechianum* L. | Fabaceae | Whole plant | -            | Abortifacient      | [120]      |
| 112.   | *Hamelia erecta* Jacq | Rubiaceae | Leaf      | -            | Abortifacient      | [121]      |
| 113.   | *Hedeoma pulegoides* Linn. | Labiatae | Plant without root | -     | Contraceptive and Abortifacient | [122] |
| 114.   | *Hedera helix* Linn. | Araliaceae | Fruit     | -            | Contraceptive      | [111]      |
| 115.   | *Hibiscus rosa-sinensis* Linn. | Malvaceae | Root      | Rats & Mice | Anti-implantation & Uterotropic activity | [123] |
| 116.   | *Hyptis suaveolens* Poit. | Labiatae | Whole plant | Mice        | Antifertility      | [124]      |
| 117.   | *Hypochoeris brasiliensis* (Less.) Benth | Asteariae | Leaf & Root | -            | Contraceptive      | [125]      |
| 118.   | *Hypericum chinensis* Linn. | Clusiaceae | Leaf      | -            | Emmenagogue        | [126]      |
| 119.   | *Hymenaea stigonocarpa* Mart. Ex Hayne | Fabaceae | Bark      | -            | Contraceptive      | [127]      |
| 120.   | *Indigofera linnaei* Ali | Fabaceae | Herb      | rats         | Anti-fertility activity | [128] |
| 121.   | *Jacaranda copaia* (Aublet.) D. Don | Bignonieae | Tuber     | -            | Contraceptive      | [127]      |
| 122.   | *Jasminum multiflorum* (Burm.) Andrews | Oleaceae | -         | -            | Emmenagogue        | [129]      |
| 123.   | *Jardinia thombifolia* (Hook. & Arn.) Reissek. | Santalaceae | Leaf      | -            | Abortifacient      | [130]      |
| 124.   | *Juglans regia* Linn. | Juglandaceae | Leaf     | -            | Contraceptive      | [111]      |
| 125.   | *Juniperus communis* Linn. | Cupressaceae | Stem & Fruit | -        | Anti-implantation activity | [14, 131] |
| 126.   | *Juniperus oxycedrus* Linn. | Cupressaceae | Berry     | -            | Abortifacient      | [132]      |
| S. no. | Name of the plant                        | Family          | Part used | Animal model | Mechanism of action                        | Reference |
|-------|-----------------------------------------|-----------------|-----------|--------------|--------------------------------------------|-----------|
| 127.  | Justicia simplex D. Don                 | Acanthaceae     | Root      | -            | Contraceptive                              | [133]     |
| 128.  | Kopsia SP                               | Apocynaceae     | Leaf      | -            | Contraceptive                              | [106, 134]|
| 129.  | Laurus nobilis Linn.                    | Lauraceae       | Leaf      | Rats         | Testicular dysfunction                     | [135]     |
| 130.  | Lawsonia inermis Linn. syn. L. alba     | Lythraceae      | Leaves    | rats         | Abortifacient                              | [136]     |
| 131.  | Leonotis nepetaefolia R.Br.             | Labiatae        | Leaf      | Rats         | Anti-implantation                          | [137]     |
| 132.  | Lepidium meyenii Walp.                  | Brassicaceae    | Root      | Rats         | invigorates spermatogenesis in male rats   | [138]     |
| 133.  | Lepidium sativum Linn.                  | Brassicaceae    | Herb      | -            | Abortifacient & Anti-Ovulatory             | [139]     |
| 134.  | Licuala SP                              | Arecaceae       | Root bark | -            | Contraceptive                              | [111]     |
| 135.  | Ligusticum porteri Coul. And Rose       | Apiaceae        | Root      | -            | Emmenagogue                                | [140]     |
| 136.  | Lithospermum officinale Linn.           | Broaginaceae    | Leaves    | Rat          | Inhibition of hypophyseal hormone secretion| [141]     |
| 137.  | Lobelia nicotianifolia Heyne            | Campanulaceae   | Whole plant| -            | Contraceptive                              | [142]     |
| 138.  | Lonicera ciliosa                        | Caprifoliaceae  | Leaf      | -            | Contraceptive                              | [143]     |
| 139.  | Malaviscus conzattii Greenm             | Malvaceae       | Flower    | Albino Mice  | Antifertility activity                     | [144]     |
| 140.  | Martynia annua Linn.                    | Martyniaccae    | Root      | Rats         | Anti-fertility Effect                      | [145]     |
| 141.  | Melodinus fusiformis Champ. Ex Benth.   | Apocynaceae     | -         | -            | Spermicidal Effect                         | [146]     |
| 142.  | Mentha arvensis                         | Fabaceae        | Leaves    | Rabbits      | Anti-Ovulatory                             | [147]     |
| 143.  | Millettia auriculata Baker. ex, Brand.  | Fabaceae        | Leaves    | Rat          | Anti-Implantation effect                   | [148]     |
| 144.  | Momordica charantia Linn.               | Cucurbitaceae   | Seeds     | Rats         | Antispermaticigenic                       | [149]     |
| 145.  | Mondia whitei Skeels                    | Apocynaceae     | Root bark | Rat          | Antispermaticigenic & Anti fertility activities| [150]     |
| 146.  | Mucuna urens Medik.                     | Fabaceae        | Seed      | Rat          | Antispermaticigenic                       | [151]     |
| 147.  | Myristica fragrans Hout.                | Myristiaceae    | Seed      | -            | Abortifacient                              | [152]     |
| 148.  | Mesua ferrea Linn.                      | Clusiaceae      | Flowers   | Rat          | Anti-implantation                          | [153]     |
| 149.  | Nardostachys jatamansi DC.              | Valerianaceae   | Root      | -            | Emmenagogue                                | [154]     |
| 150.  | Nasturtium officinale R.Br.             | Brassicaceae    | Whole Plant| -            | Abortifacient                              | [33]      |
| 151.  | Neriun indicum Mill.                    | Aocynaceae      | Whole Plant| -            | Emmenagogue                                | [155]     |
| 152.  | Nicotiana tabacum Linn.                 | Solanaceae      | Leaves    | Rat          | Antianandrogenic effects                   | [156]     |
| 153.  | Nigella sativa Linn.                    | Ranunculaceae   | Seeds     | Rat          | Post-Coital Antifertility effect           | [157]     |
| 154.  | Nothocnide repanda (Bl.) Bl.             | Utricaceae      | Leaf      | -            | Abortifacient                              | [106]     |
| 155.  | Ochna jabetapita Linn.                  | Ochnaceae       | Plant (Without root) | - | Semen coagulating activity                | [158]     |
| S. no. | Name of the plant                     | Family       | Part used | Animal model | Mechanism of action                        | Reference |
|-------|--------------------------------------|--------------|-----------|--------------|--------------------------------------------|-----------|
| 156.  | Ocimum sanctum Linn.                  | Labiatae     | Leaves    | Rats         | Antiandrogenic Property                     | [159]     |
| 157.  | Olea europea Linn.                    | Oleaceae     | Fruit     | Rats         | Contraceptive                              | [160]     |
| 158.  | Ophiopogon intermedius (D.Don)        | Asparagaceae | Rhizomes   | -            | Spermicidal                                | [161]     |
| 159.  | Opuntia dilleni Haw.                  | Cactaceae    | Phylloclade| Rats         | Spermatotoxic                              | [162]     |
| 160.  | Oliganum vulgare Linn.                | Labiatae     | -          | -            | Abortifacient                              | [163]     |
| 161.  | Oxalis physocalyx Zucc.ex Progel      | Oxalidaceae  | Whole Plant| -            | Abortifacient                              | [127]     |
| 162.  | Oxytenanthera abyssinica Munero       | Poaceae      | Leaf       | -            | Abortifacient                              | [108, 164]|
| 163.  | Papaver somniferum Linn.              | Papaveraceae | Fruit     | -            | Induces Abortion                           | [33]      |
| 164.  | Peganum harmala Linn.                 | Zygophyllaceae| Epigeal Plants| Rats | Abortifacient                              | [165]     |
| 165.  | Petrocarpus santalinus Linn.f.        | Fabaceae     | Stem Bark  | Rats         | Anti-implantation activity                 | [166]     |
| 166.  | Piper longum Linn.                    | Piperaceae   | Fruit      | Rats         | Antifertility Activity                     | [167]     |
| 167.  | Pittosporum neelgherrense Wight & An. | Pittosporaceae| Plant (Without Root)| Rats | Spermioidal and Semen Coagulation | [168]     |
| 168.  | Plumbago zeylanica Linn.              | Plumbaginaceae| Leaves & Root| Rats | oestrogenic activity | [169, 170]|
| 169.  | Plumeria rubra Linn.                  | Apocynaceae  | Pod Extract| Rats         | Anti-implantation activity                 | [171]     |
| 170.  | Polemonium caeruleum Linn.            | Polemoniaceae| -          | -            | Antispermatogenic effect                   | [172]     |
| 171.  | Primula vulgaris Huds.                | Primulaceae  | -          | -            | Spermicidal effect                         | [81, 173] |
| 172.  | Pueraia tuberosa DC.                  | Fabaceae     | Tubers     | Rats         | Antifertility activity                     | [14, 174] |
| 173.  | Portulaca oleracea Linn.              | Portulacaceae| Seed       | Mice         | Impairement of Spermatogenesis             | [175]     |
| 174.  | Prurus cuspidata Bertol               | Rosaceae     | Whole Plant| -            | Spermicidal effect                         | [22]      |
| 175.  | Quassia amara Linn.                   | Simaroubaceae| Stem wood  | Rats         | Antifertility activity                     | [16, 176] |
| 176.  | Randia dumetorum Lamk.                | Rubiaceae    | -          | -            | Anti-implantation effect                   | [131]     |
| 177.  | Randia spinosa (Thumb.) Bl.           | Rubiaceae    | Fruit      | -            | Antifertility activity                     | [95, 177] |
| 178.  | Ranunculus sceleratus Linn.           | Ranunculaceae| Whole Plant| -            | Antifertility activity                     | [154]     |
| 179.  | Rauwolfa serpentine Benth.            | Apocynaceae  | Root       | -            | Antifertility activity                     | [178]     |
| 180.  | Rhamnus catharticus Linn.             | Rhamnaceae   | -          | -            | Emmenagogue                                | [179]     |
| 181.  | Ricinus communis Linn.                | Euphorbiaceae| Seed       | Guinea Pigs  | Anti-implantation and Abortifacient        | [180]     |
| 182.  | Rubia cordifolia Linn.                | Rubiaceae    | Root       | -            | Antifertility activity                     | [155]     |
| 183.  | Rubus ellipticus Sm.                  | Rosaceae     | Leaves     | Rats         | Anti-implantation Effect                   | [181]     |
| 184.  | Ruta angustifolia Linn.               | Rutaceae     | Leaf       | -            | Antifertility activity                     | [154]     |
| 185.  | Ruta graveolens Linn.                 | Rutaceae     | Aerial parts and Roots | Rats and hamsters | Anticonceptive activity                  | [182]     |
| S. no. | Name of the plant | Family | Part used | Animal model | Mechanism of action | Reference |
|-------|------------------|--------|-----------|--------------|---------------------|-----------|
| 186.  | *Salvia fruticosa* Mill. | Labiatae | Leaves | Rats | Anti-implantation Effect | [183] |
| 187.  | *Samida rosea* Sims. | Flacourtiaceae | Leaf | Rats | Abortifacient and Emmenagogue | [101, 184] |
| 188.  | *Santalum album* Linn. | Santalaceae | Whole Plant | - | Abortifacient | [185] |
| 189.  | *Sapindus mukorossi* Gacrt | Sapindaceae | Fruit Pericarp | Rats | Alteration in Sperm membrane physiology | [186] |
| 190.  | *Sarcostemma acidum* (Roxb) Voigt | Apocynaceae | Stem | Rats | Arrests Spermatogenesis | [187] |
| 191.  | *Scilla indica* (Baker) | Liliaceae | Bulb | - | Emmenagogue | [188] |
| 192.  | *Semecarpus anacardium* Linn. | Anacardiaceae | Fruits | Rats | Spermatogenic arrest | [189] |
| 193.  | *Solanum surattense* Burm.f. | Solanaceae | Seed | Rats | Deplete the oxidative stress of cauda epididymal spermatozoa | [190] |
| 194.  | *Stephania hernandifolia* Willd. | Menispermaceae | Leaf | Rats | Inhibition of spermatogenesis | [191] |
| 195.  | *Stevia rebaudiana* Bertoni | Amaryllidaceae | Whole plant | Rats | Decrease in Testosterone Level | [192] |
| 196.  | *Striga orobanchoides* Benth | Scrophulariaceae | Whole Plant | Rats | Antispermatic effect | [193] |
| 197.  | *Syzygium cumini* Linn. Syn. *Eugenia jambolana* Lam. | Myrtaceae | Oleanolic acid isolated from the flowers of *Eugenia jambolana* | Rats | Arrest of spermatogenesis | [194] |
| 198.  | *Tagetes erecta* L. | Asteraceae | leaves | - | Emmenagogue | [195] |
| 199.  | *Tanacetum parthenium* L.Sch. | Asteraceae | Plant without Root | - | Abortifacient | [112] |
| 201.  | *Taxus baccata* Linn. | Taxaceae | Leaves | Rats | Antifertility | [196] |
| 202.  | *Terminalia arjuna* Wight & Arn. | Combretaceae | Bark | - | Antispermatic effect | [197] |
| 203.  | *Tinospora cordifolia* (Willd.) Miers ex Hook.f. Thoms | Menispermaceae | Stem | Rats | Reduction in testosterone levels | [198] |
| 204.  | *Trichosanthes cucumerina* Linn. | Curcurbitaceae | Whole plant | Rats | Antiovulatory activity | [199] |
| 205.  | *Trigonella foenungraecum* Linn. | Fabaceae | Seeds | Rabbits | Antifertility activity | [200] |
| 206.  | *Tripterygium hypoglaucum* (Level) Miers ex Hook.f. Hutch | Celastraceae | Root Xylem | Humans | Reduced Sperm concentration and motility | [201] |
| 207.  | *Tripterygium wilfordii* Hook f. | Celastraceae | Root and Isolated plant fractions | Rats and Humans | Reversible infertility | [202] |
| 208.  | *Tylophora asthmatica* Wight & Arn. | Apocynaceae | Leaf and Stem | Rat | Antispermatic effect | [203] |
| 209.  | *Uraria lagopodioides* Desv. | Fabaceae | Whole plant | - | Abortifacient effect | [204] |
| 210.  | *Urena lobata* Linn. | Malvaceae | Root | Rat | Inhibition of Spermatogenesis and | [205] |
| S. no. | Name of the plant                          | Family          | Part used | Animal model | Mechanism of action          | Reference |
|-------|--------------------------------------------|-----------------|-----------|--------------|-------------------------------|-----------|
| 211.  | *Urginea indica* Kunth.                    | Liliaceae       | Bulb      | -            | Steroidogenesis               | [206]     |
| 212.  | *Uritica dioica* Linn.                     | Urticaceae      | -         | -            | Abortifacient effect          | [207]     |
| 213.  | *Urospatha antisylleptica* R.E. Schult.    | Araceae         | -         | -            | Abortifacient effect          | [208]     |
| 214.  | *Valeriana Montana* Linn.                  | Valerianaceae   | Root      | -            | Sterilizer                    | [209]     |
| 215.  | *Ventilago neo-caledonica* Schlecht.       | Rhamnaceae      | Leaf      | -            | Contraceptive                 | [210]     |
| 216.  | *Vernonia amygdalina* Delile (Linn.) Walp  | Asteraceae      | Root      | -            | Antifertility effect          | [211]     |
| 217.  | *Viburnum foetidum* wall                   | Caprifoliaceae  | Leaf      | -            | Emmenagogue                   | [154]     |
| 218.  | *Vigna unguiculata*                        | Fabaceae        | -         | Rat          | Antifertility effect          | [212]     |
| 219.  | *Vitex negundo* L. (Cowpeas)               | Lamiaceae       | Seeds     | Dog          | Anti-Androgenic Effect        | [213]     |
| 220.  | *Waltheria Americana* Linn.                | Sterculaceae    | -         | -            | Abortifacient Effect          | [214]     |
| 221.  | *Wedelia gracilis* Rich                    | Asteraceae      | Whole plant | -            | Abortifacient Effect          | [215]     |
| 222.  | *Wedelia trilobata* (L.) Hitch.            | Asteraceae      | -         | -            | Antifertility effect          | [216]     |
| 223.  | *Withania coagulans* (Stocks.) Dunal       | Solanaceae      | Fruit     | -            | Emmenagogue                   | [217]     |
| 224.  | *Withania sommifera* Dunal                 | Solanaceae      | Fruit     | Rats         | Decreased Sperm motility      | [218]     |
| 225.  | *Xanthium spinosum* Linn.                  | Astersaceae     | Leaf      | -            | Contraceptive                 | [132]     |
| 226.  | *Xylopia aethiopica* (Dunal) A. Rich       | Annonaceae      | Fruit     | Rats         | Antifertility effect          | [219]     |
| 227.  | *Zaluzania triola* (Ort.) Pers.            | Asteraceae      | Plant without root | - | Abortifacient                     | [112]     |
| 228.  | *Zingiber roseum* (Roxb.) Roscoe          | Zinziberaceae   | Stem      | -            | Antifertility                 | [220]     |
| 229.  | *Zinziber officinale* Rosc                 | Zinziberaceae   | Rhizome   | Rats         | Abortifacient                 | [33]      |
| 230.  | *Ziziphora tenuior* Linn                   | Labiatae        | Seed      | -            | Emmenagogue                   | [86]      |
| 231.  | *Ziziphus nummularia* (Burm.f.)            | Rhamnaceae      | Root bark | -            | Abortifacient                 | [221]     |
| 232.  | *Zizyphus jujuba* Mill.                    | Rhamnaceae      | Bark      | -            | Antifertility                 | [222]     |
| 233.  | *Zizyphus xylopyrus* (Retz.) Wild.         | Rhamnaceae      | Fruit     | -            | Induces Sterility             | [223]     |
5. CONCLUSION

In conclusion, it is clear that medicinal plants play an important role as antifertility agents. Despite of various commercially available oral contraceptives in the market, herbal antifertility agents shows promising output by minimizing the number of adverse drug properties. Current research towards traditional medicine is growing rapidly because of its safety and less cost consumption.

Moreover the present review has provided latest information regarding new plant species which are not covered till now, and many of them still lacks suitable scientific evidence despite of their antifertility claims. This makes the researchers to carry out their research on such antifertility agents which lacks suitable evidence. As listed many of the 233 plant species appear to be an effective alternative to the commercial antifertility compounds.

6. LIMITATIONS AND FUTURE RECOMMENDATIONS

Majority of plants mentioned in this review has been used as traditional antifertility agents, have not been thoroughly and scientifically studied on animals. Present data also lacks in providing information on toxic effects of tested extracts, and also the information regarding studies carried out on human subjects. Hence, it is clear that further investigation is required to potentiate the effects of medicinal plants as antifertility agents in both animals and humans. Therefore significant research is required to be done to investigate the chemical and biological properties of such less explored plants.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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