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SECONDARY METABOLITE PRODUCTION FROM MEDICINAL PLANTS FOR THE TREATMENT OF FEMALE INFERTILITY: A REVIEW

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ABSTRACT: Folk medicines play an important role to cure human diseases. In India, there are various system of medicinal practices like Ayurveda, Unani, Homoeopathy, Allopathy, and Siddha etc. The common female gynecological disorders are such as amenorrhea, dysmenorrheal, leucorrhea, menometrorrhagia, metrorrhagia, oligomenorrhea, hemorrhage, gonorrhea, syphilis which leads to the female infertility. Plant tissue culture technique occupies the key role in the enhancement of secondary metabolites production by using different elicitors which yield an interesting product of plant constituents leads to second green revolution. In this review, updated information is gathered on scientifically proven medicinal plants used for the treatment of female infertility. The aim of this review is to highlight on various plant drugs which is enhanced by different elicitors that may help investigators to identify suitable medicinal plants to cure female infertility.

KEYWORDS: Secondary metabolites, Infertility, Gynecological disorder, Elicitors.

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1.INTRODUCTION

According to the United Nations Population Division, “Fertility is the natural human capability of producing offspring [1]. According to recent studies by the World Health Organization (WHO), approximately 8-10% of couples are facing some kind of infertility problems [2]. Infertility is an inability to conceive and produce the child. Eight out of every ten women trying for a baby, will fall pregnant within the first six months [3] and the reasons behind it are such as weight, diet, smoking,

other substance abuse, environmental pollutants, infections, medical conditions, medications, the quantity and quality of the sperm and family medical history could affect conception in couples [1]. Assisted Reproductive Technology has been carried out such as IVF, ICSI but common people cannot afford the cost of such procedures [3]. There is various system of medicine like Ayurveda, Unani, Homoeopathy, Allopathy, Siddha and physiotherapy with acupuncture are been effective to enhance the pregnancy [4]**.** Approximately 90% of the ingredient used in Ayurveda, Unani, Siddha and Homeopathy medicine are plant based over in modern Allopathic medical system has 25% of its formulation from herbal medicine [5]. Hence, the use of herbal medicine is increasing day by day, due to the concept of natural drugs are cheaper with no fear of any side effects [6,7.8.9]. Due to over exploit of traditional medicinal plants, low yielding and loss of growth habitat, the genetic biodiversity of traditional medicinal plants is under a continuous threat of extinction [10]. Because of this there is need to provide alternate methods to propagate, cultivate and conserve the common as well as endangered medicinal plants and also to maintain the balance of eco-system [5].

Table 1: Significance of medicinal plants used to cure female infertility

Common name	Botanical name	Family	Parts used	Activities	References
Guyebabla	*Acacia farnesiana* Willd. (T)	Mimosaceae	Bark	To cure leucorrhea and menorrhagia	[4]
Satamuli	*Asparagus racemosus* Willd.(H)	Liliaceae	Root	To cure leucorrhea and abnormal discharges of semen.	[4,11]
Neem	*Azadirachta indica* A.Juss (T)	Meliaceae	Stem, bark and fruit	To control menstrual cycle and also help in follicular	[4,12]
Bhuikumra	*Ipomoea paniculata* L.R.Br	Convolvulaceae	Root	To cure menorrhagia, gonorrhoea, and syphilis. It also acts as an aphrodisiac.	[4,11]
Kemanch	*Mucuna pruriens* (Linn.) DC (C)	Fabaceae	Seed	To cure leucorrhoea and menrrhagia. And also effective both for men and women in case of impotency	[4,11]

Bhuiamala	*Phyllanthus niruri* Hoof.f. non Linn (H)	Euphorbiaceae	Whole plant	To cure menorrhagia and gonorrhoe	[4]
Pila berela	*Sida acuta* Burm. f.(S)	Malvaceae	Leaf, root ,seed	To cure leucorrhoea and gonorrhea	[4,11]
Aswagandha	*Withania somnifera* Dunal. (H)	Solanaceae	Root	To cure leucorrhoea , menstrual troubles and very effective in case of female	[4]

There are two main approaches in the conservation of medicinal plants – in-situ and ex-situ conservation. In *in-situ* conservation of plants in their natural habitats, while in *ex-situ* methods, plant biotechnology offers the most appropriate way of conservation and large-scale production of plants using plant tissue culture techniques. Plant tissue culture is the science & art of growing plant cell, tissues, organs or whole plants on semi-solid or in liquid synthetic nutrient media under aseptic and controlled environmental condition. Higher plants are valuable source for natural drugs, which include flavours, fragrances, essential oils, phytochemical compounds collectively referred as Secondary metabolites [13]. This review, highlights the important medicinal plants and their drugs which help to cure female infertility and conserve by using the advanced biotechnological methods. Plant cell and organ cultures are important techniques to obtain valuable metabolites through callus and cell suspension culture. In vitro propagation via indirect organogenesis or embryogenic calli is an important for isolation of active secondary metabolites which are valuable sources of pharmaceutical industries. Plant cell cultures have great advantages in biosynthesis and metabolite production from a very small amount of plant material leads to develop a higher amount of natural drugs for herbal medicines in short period of time. Cell suspension culture offer an effective mechanism when incorporated with elicitors into the cell which can lead to production of novel natural drugs not previously found in whole plants [13]. Elicitors is a stress agent which enhances the production of secondary metabolites in particular tissue, organ and cells. There are two types of elicitors, biotic (biological origin) and abiotic (non-biological origin) [14,15]. Biotic elicitors are polysaccharide, yeast extract, bacterial and fungal [16] while abiotic elicitors are divided into three group chemicals (heavy metals, mineral salts and gaseous toxins), Physical (light, thermal, osmotic, drought and salt stress), and Hormonal (salicylic acid, jasmonic acid, sucrose etc.). In the recent developments, elicitors have opened a new avenue for the production of secondary metabolite compounds [17].

Table 2: Different elicitors used in production of crucial secondary metabolites from some important medicinal plants

Sr No.	Plant Names	Explants	Elicitors	Compounds	References
1	*Azadirachta indica* A.Juss (T)	Seeds	Glucose, Hydrolyzed casein and Methyl jasmonate	Azadirachtin	[18]
2	*Azadirachta indica* A.Juss (T)	Seeds	Cyanobacteria*: Anabaena sp., Nostoc carneum,*	Azadirachtin	[19]
3	*Azadirachta indica* A.Juss (T)	Shoot segments	Salicylic acid, Jasmonic acid, Cadmium chloride and Sodium chloride	Azadirachtin	[20]
4	*Azadirachta indica* A.Juss (T)	Hairy root	*Claviceps purpurea*	Azadirachtin	[21]
5	*Azadirachta indica* A.Juss (T)	Seeds	Salicylic acid, Chitosan, Jasmonic acid, Methyl jasmonate, Yeast extract	Azadirachtin	[22]
6	*Asparagus racemosus* Willd.(H)	Nodal segments and roots	*Fusarium oxysporium* and *Rhiizopus stolonifera* UV and Salicylic acid	Shatavarins	[23]
7	*Asparagus racemosus* Willd.(H)	Nodal segments	UV-B	Shataverins	[24]
8	*Mucuna pruriens* (Linn.) DC (C)	Seeds	Methyl jasmonate, Chitin, Pectin, Yeast extract	L-Dopa (3, 4-dihydroxy-L-phenylalanine)	[25]
9	*Withania somnifera* Dunal. (H)	Roots	Cadmium chloride, Aluminum chloride and Chitosan,	Withanolides	[26]
10	*Withania somnifera*	Cell	pH and Sucrose	Withanolide A	[27]

	Dunal. (H)	suspension			
11	*Withania somnifera* Dunal. (H)	Hairy root	pH	Withanolide A	[28]
12	*Withania somnifera* Dunal. (H)	Hairy root	Methyl jasmonate and Salicylic acid	Withanolide A, Withanone, and Withaferin A	[29]
13	*Withania somnifera* Dunal. (H)	Leaves	Calcium chloride, Copper sulphate and Cinnamic acid, *Fusarium solani, Alternaria alternate* and *Verticillium dahliae*	Withaferin A	[30]
14	*Withania somnifera* Dunal. (H)	leaf, cotyledon and internode explants	Aluminium chloride, Chitosan	withanolides	[31]
15	*Withania somnifera* Dunal. (H)	leaf	Methyl jasmonate and Salicylic acid	withanolide A, withanolide B, withaferin A, and withanone, 12-deoxy withastramonolide, withanoside V, and withanoside IV	[32]
16	*Withania somnifera* Dunal. (H)	leaf	Chitosan, Nitric oxide, Jasmonic acid, Acetyl salicylic acid	withaferin A, withanolide A	[33]

2. CONCLUSION

Greater efforts are required to document this traditional knowledge of local medicinal plants which are safe, less costly and eco-friendly method for the treatment of gynecological disorders. There is a scope for the large–scale production of secondary metabolites available from these plants by using the elicitors as an agent. Biotic and abiotic elicitors enhanced the secondary metabolites production

for isolation of bioactive compound from important medicinal plants to cure gynecological disorders. One of the main problems for secondary metabolites production is the limited knowledge of biosynthetic pathways and their controlling enzymes and genes regulation. As the little information about pathways of these plants is needed to understand, for isolation of large amount of natural drugs, to treat many gynecological disorders.

CONFLICT OF INTEREST

The authors report no conflicts of interest.

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