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## **Herbs for Polycystic Ovary Syndrome (PCOS): A Review of its Therapeutic Potential**

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### **ABSTRACT:**

**BACKGROUND:** Millions of women worldwide suffer from PCOS. It is a hormonal imbalance that occurs when your ovaries (the organ that produces and releases eggs) create excess hormones which leads to infertility and metabolic problems. Because side effects from conventional medicines are common, interest in alternative therapies has grown. Herbal treatment presents a potentially effective method, as some herbs have shown promise in reducing the symptoms of PCOS. This review examines the therapeutic effects of various herbs which can be used in the treatment of various symptoms of PCOS.

**METHODS:** A comprehensive literature search was done using major databases such as PUB MED, research gate, google scholar, science direct etc. relevant studies were done on herbal remedies for PCOS were selected and reviewed.

**RESULT:** Herbal Remedies have showed significant effect in treating PCOS due to its different phytochemical constituents and also due to its various Pharmacological actions.

**CONCLUSION:** As PCOS have been increasing day by day, herbal remedies turned out to be a better option for its treatment.

**KEYWORDS:** anti-androgens, estrogen, herbs, hormonal imbalance, infertility, PCOS

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### **1. INTRODUCTION:**

PCOS is characterized by ovarian cysts, anovulation, and endocrine variance that affect women. The World Health Organization (WHO) estimated that approximately 116 million women globally (3.4%) suffer from it. It is a heterogeneous syndrome and is one of the leading causes of hirsutism and infertility in women. PCOS in adolescents is difficult to diagnose because of common puberty characteristics. (2) Less production of estrogen and excess production of androgens can lead to small cysts on the surface of ovaries. (3) It is a serious gynaecological endocrinopathy that has long-term detrimental consequences for women's physical and mental health. It affects around 5-20% of reproductive age women, but it depends on the diagnostic criteria. Understanding and controlling PCOS is critical for persons who are going through this, because it can lead to a variety of long-term disorders such as heart disease, increased risk of type-2 diabetes, and difficulties during pregnancy. (4) Oligomenorrhea is one of the most common menstrual bleeding disorders. Individuals suffering from oligomenorrhea typically have 5-7 cycles annually or menstrual intervals longer than 35 days, but shorter than 90 days. (5)

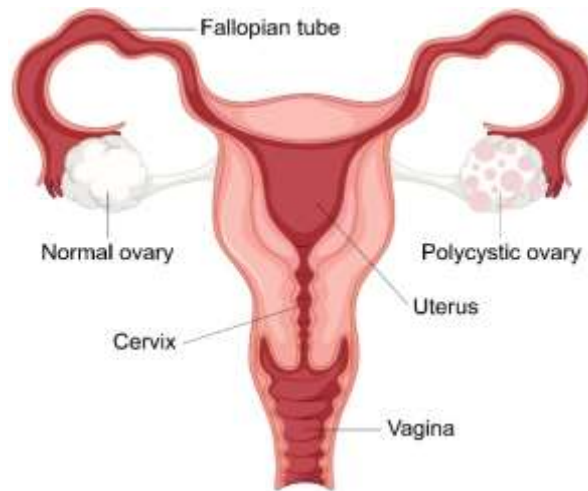


Fig 1: Polycystic Ovary Syndrome

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## 2. CAUSES\ETIOLOGY:

- PHYSICAL AND EMOTIONAL STRESS
- INSULIN RESISTANCE
- HYPERANDROGENISM
- INFLAMMATIONOXIDATIVE STRESS
- OBESITY
- DIET (6)

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## 3. SYMPTOMS:

- High Level Of Male Hormones
- irregular or skipped periods.
- Excess body hair (hirutism)
- acne.
- Weight gain
- infertility
- darkening of the skin
- .headache (7,8)

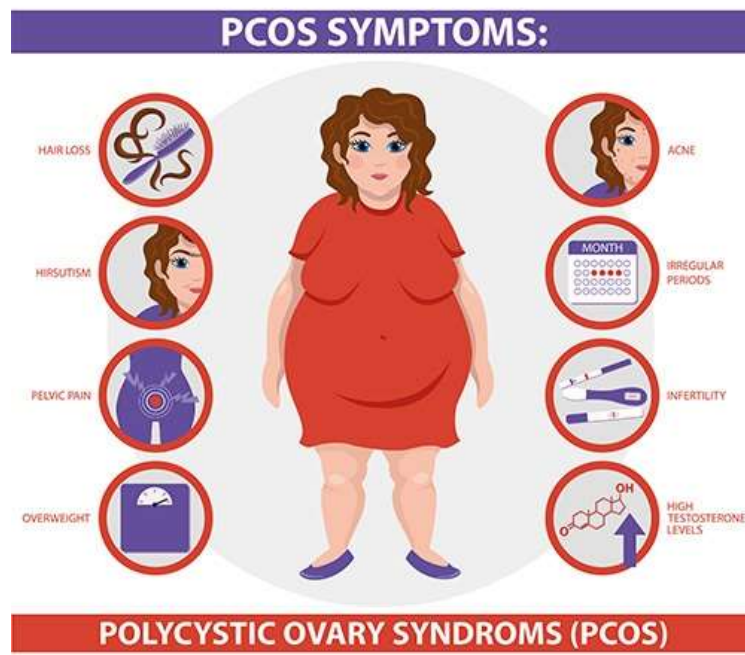


FIG 2: Symptoms Of PCOS

#### 4. Histological features of PCOS

- Whole ovarian hypertrophy
- Thickened capsule
- Hyperplasia and fibrosis of the ovarian stroma
- Premature leutinization of theca cells
- Increased number of sub capsular follicle cysts(8)

#### 5. VARIOUS HERBS USED TO TREAT PCOS ARE AS FOLLOWS:

##### 5.1 CINNAMON:

It has been a common spice used for thousand of years by many cultures worldwide. It belongs to the Lauraceae family of laurel plants, (9) originating from a Greek term meaning pleasant wood, it is obtained from the inner bark of tropical evergreen cinnamon trees. (10) Numerous research on the impact of species, origin and plant component on the chemical makeup of cinnamon essential oil have been reported. (11) It contains a range of resinous substances including essential oils, cinnamaldehyde, cinnamic acid and cinnamate. (12) In one study, fifteen PCOS-afflicted women were given 333 mg of cinnamon extract orally three times a day for eight weeks. The patients underwent insulin sensitivity testing both before and after receiving cinnamon extract. Two hours after ingesting the extract, the patients' insulin levels significantly decreased, according to the data. By raising phosphatidylinositol-4-kinase activity, cinnamon reduced insulin in patients. (13)



**FIG 3: Cinnamon**

### **5.2 FENNEL:**

Fennel (*Foeniculum Vulgare*) is found all over the world and is a member of the Apiaceae family. Fennel seeds have anti-inflammatory and oestrogen-promoting effects which make it more useful and help to treat PCOS (14). It has been observed that trans-anethole, fenchone, estragol (methyl chavicol) and alpha phellandrene are the main constituents of *F. vulgare* seed essential oil (15). The content of trans-anethole, which is considered as the main component, varies between 81.63% - 87.85% (16). PCOS can be managed with the help of fennel seeds, because of the high phytoestrogen content of fennel, there is less inflammation linked to PCOS and less insulin resistance. It gives relief from menopausal symptoms with phytoestrogen. There is a noticeable reduction in cellular imbalance. Therefore, it might help with the control of metabolic disruption linked to PCOS (17). Seeds of fennel are used in the treatment of PCOS because they contain anti-hirsutism properties and also the androgen (male hormone) levels are also decreased (18). A study looked at the benefits of topical fennel gel at 1% and 2% on mild to moderate cases of idiopathic hirsutism. Patients who took 1% fennel topical gel had a 7.8% decrease in hair thickness, according to an assessment of hair growth speed and thickness based on patient satisfaction and hair thickness measurement. On the other hand, individuals who applied 2% fennel topical gel had a notable decrease in hair thickness and a substantial impact on hair growth speed (19).



**FIG 4 :Fennel**

### **5.3 ALOE VERA:**

*Aloe barbadensis* miller is the botanical name for aloe vera. It is a member of the Liliaceae family (20). It is referred to in Ayurveda as kumari and arthavajanaka, which both imply menstruation inducer. According to in-vitro research, phytosterol, which is one of the bioactive constituents, stimulates the proteins on the estrogen receptors, raising the levels of oestrogen in PCOS patients while lowering androgen levels (21). A study was done on PCOS-afflicted rats to assess the effectiveness of aloe vera gel for PCOS management. In this study, aloe vera gel was given orally to PCOS-rats at doses of 5 mg/kg, 10 mg/kg, and 15 mg/kg for 60 days. It was found that the gel may cause changes in ovarian structure and that it significantly reduced insulin resistance. Additionally, it was discovered that the dosage of 10 mg/kg and 15 mg/kg of aloe vera gel significantly lowered testosterone (22).



**FIG 5: Aloe-vera**

#### **5.4 TURMERIC:**

*Curcuma longa*, a rhizomatous herbaceous perennial plant native to tropical South Asia and member of the Zingiberaceae family of gingers, is the source of turmeric. Around the world, 133 different species of *Curcuma* have been recognised.(23) There is no doubt that curcumin protects ovarian tissue. This substance appears to be implicated in ovarian angiogenesis inhibition, ovarian fibrosis prevention, and matrix degradation through the inhibition of vascular endothelial growth factor(VEGF) expression, a proangiogenic factor intimately linked to the development of PCOS(24)



**FIG 6: Turmeric**

After receiving a daily dosage of 93.34 mg (2 capsules) for eight weeks, thirty newly diagnosed PCOS women showed comparable inhibitory action by lowering DHEA, LH, FSH, and testosterone(25)results from curcumin extract or compound clinical trials on PCOS-afflicted women were comparable to those of animal tests. Curcumin extract or related substances decreased dehydroepiandrosterone (DHEA) and insulin in a clinical investigation on women with PCOS [26]. Another study revealed that curcumin (1500 mg/day for 12 weeks) boosted oestradiol rather than suppressing DHEA in women (18–49 years old) with PCOS for at least two years.(27)

#### **5.5 Green tea :**

tea is the most popular drink in the world after water ,and one of the most drunk globally. when it comes to antioxidants, green tea has more than other types of tea. In addition to caffeine, minerals,,and trace amounts of vitamins, amino acids, and carbs ,tea also contains polyphenols.(28) Furthermore, Tehrani et al.'s study discovered that giving PCOS patients 500 mg of GTE supplementation for 12 weeks resulted in a statistically significant weight loss ( $P < 0.05$ ). Additionally, it has been shown that green tea extract (GTE) may help women with PCOS with their glycaemic indices. There is strong evidence that improving insulin resistance and therefore lowering blood insulin levels improves hormonal imbalance and triggers ovulation in PCOS patients. Green tea's powerful antioxidants, called catechins, work to lower the hormone levels that cause ovarian cysts and the symptoms associated with them.(29)



**FIG 7: Green Tea**

#### **5.6 PUMPKIN SEEDS:**

the pumpkin is a member of the Cucurbitaceae family and is commonly cultivated as a vegetable across the world.(30) Pumpkin seeds are rich in linoleic acid, stearic acid, oleic acid, and palmitic acid, among other nutraceutical ingredients. These important fatty acids are part of the omega 3 or omega 6 group, which has amazing nutritional properties and is crucial for many metabolic processes.(84)The healthy  $\omega$ -3 fatty acids found in pumpkin seeds can also aid in regulating the increased insulin and cholesterol levels linked to PCOS.



**FIG 8: Pumpkin Seeds**

Moreover, they contain beta-sitosterol, which can alleviate symptoms of PCOS like hirsutism and lessen excess androgen.(31)

#### **5.7 LIQUORICE:**



**FIG 9:Liquorice**

The plant liquorice, *Glycyrrhiza glabra* L., is a member of the Astragaleae tribe of the Fabaceae family. Greek etymology for the word Glycyrrhiza is "sweet wood."(32) Studies have demonstrated that glycerin inhibits the enzyme 11beta-hydroxysteroid dehydrogenase type 2 (11betaHSD2), which results in a mineralocorticoid-like action. Glucocorticoids elevate blood levels by blocking their metabolism. Moreover, glucocorticoids decrease blood sugar by stimulating the release of insulin.(13)

### 5.8 FLAX SEED:

A member of the Linaceae family, flax (*Linum usitatissimum*) has a crisp texture and nutty flavour (Rubilaret al., 2010). Another word for flaxseed is linseed.(33) Clinical trials indicate that dietary supplementation with FLaxseed in PCOS patients can reduce BMI and weight. Additionally, a number of research examined the effects of flaxseed on ovarian morphology, demonstrating a significant decrease in ovarian volume and follicle count in addition to regular menstrual cycles (34)



**FIG 10 :Flax Seed**

### 5.9 SPEARMINT:

The fragrant, rhizomatous, perennial herb spearmint (*Mentha spicata* L.) is a member of the Lamiaceae family . Because they are abundant in polyphenols, the plants in this family have potent antioxidant qualities(35) The effectiveness of spearmint tea in lowering hirsutism in females with Polycystic Ovary Syndrome (PCOS) was examined in a 30-day randomised controlled experiment. The following were the outcomes: - Lower levels of total and free testosterone - Higher levels of LH and FSH - Better self-reported hirsutism(36)



**FIG 11: Spearmint**

### 5.10 TULSI:

Native to the Indian subcontinent, tulsi (*Ocimum sanctum* L.), sometimes known as holy basil, is highly esteemed for its curative properties within the Ayurvedic and Siddha therapeutic frameworks. (37) It contains strong anti-androgenic qualities that reduce the synthesis of androgens (Hyperandrogenis)(38) The sacred herbal plant Tulsi is mostly used in medicine to treat obesity and hypoglycemia.(39).



**FIG 12:Tulsi**

### ***5.11 NUTMEG:***

The evergreen nutmeg tree, *Myristica fragrans*, is a member of the Myristicaceae family of flowering plants that are native to America, Asia, Africa, and the Pacific Islands.(40) This study made it clear that infertile women's blood levels of calcium and magnesium decreased when their ovaries were stimulated and their oestrogen levels were downregulated.(17)



**FIG 13:Nutmeg**

### ***5.12 Coconut OIL:***

One of the palm trees that is most extensively and commonly used is the coconut tree (*Cocos nucifera*). It is said that the coconut palm is the "tree of life," or "Kalpavriksha." Globally, people have been growing a variety of coconut trees.(41) In addition to lauric acid and alpha-tocopherol, the oil has a wealth of phenolic components, including flavonoids and saponins, when it comes to roots.(42) The flavonoid found in *Cocos* lowers blood glucose levels and has hypoglycemic properties. This plant contains a lipid called methyl (9Z,12Z)-9,12-octadecadienoate, which has anti-androgenic qualities. (43) Preclinical studies have demonstrated the positive effects of *Cocos nucifera* in altering the size and quantity of ovarian cysts in PCOS patients. In a similar vein, it also causes a rise in uterine weight and a suppression of ovarian weight.(44)





**FIG 14:Coconut oil**

### **5.12 GINSENG:**

it is known as the "king of all herbs," ginseng has been utilized for thousands of years in East Asian traditional medicine to heal various ailments. It has grown to be one of the most widely used herbs in the world within the past three decades.(45) Patients with PCOS who are anovulating may benefit from and find that a considerable drop in plasma LH levels improves their fertility rate . Additionally, ginseng can aid with postmenopausal symptoms like melancholy, anxiety, and sleeplessness.(44,46)



**FIG 15:Ginseng**

### **5.13 ASHWAGANDHA:**

Over three millennia have passed since the usage of the medicinal plant ashwagandha in Ayurvedic and traditional medicine.(47) Ashwagandha powder, an Ayurvedic plant that has long been known to be a powerful adaptogen, helps the body balance its hormone levels, which may reduce stress and the symptoms of PCOS.(48)



**FIG 16: Ashwagnadha**

#### 5.14 SHATAVARI:



**FIG 17:Shatavari**

*Asparagus racemosus*, also known as Satawar, Satamuli, or Satavari, is a low-lying plant that is native to India and is a member of the Liliaceae family. The plant's dried roots are used as medication.(49) More than 50 chemical substances, such as glycosides, alkaloids, polysaccharides, mucilage, racemosol, and isoflavones, are present in shatavari. It increases rat uterine weight, enhances estrogen level, and ovarian physiology(50) The estrogenic activity of shatavari's steroidal glycosides may aid in balancing hormones, particularly in women. Menstrual abnormalities and menopausal symptoms may be alleviated by them.(51)

#### 5.15 CORIANDER:

The Apiaceae (Umbelliferae) family member *Coriandrum sativum* (*C. sativum*) is well known for its applications in traditional medicine and cooking.(52) Antioxidant components found in coriander include flavonoids, terpenes, catechins, and polyphenolic chemicals. It was discovered that quercetin inhibited phosphatidylinositol 3-kinase (PI3K). Hence, it has been discovered that quercetin acts on PI3K and generally has positive effects on PCOS-affected women.(17)



**FIG 18: Coriander**

### 5.16 POMEGRANATE SEEDS:



**FIG 19: Pomegranate Seeds**

The pomegranate, or *Punica granatum* (Pg), is a member of the monogeneric family. It has also been demonstrated that Pomegranate seeds contain the estrogenic substances estrone and estradiol.(53) Pomegranate extract treatment enhanced alterations in female sex hormones in PCOS patients, according to a study by Hossein et al. (2015). It was therefore recommended to utilize this extract to lessen PCOS symptoms .in their 2019 study, Esmailinezhad et al. investigated the effects of synbiotic pomegranate juice on anthropometric indices, sex hormone profile, and blood glucose indices in patients with polycystic ovarian syndrome. They found that there was a substantial reduction in weight, BMI, and testosterone levels.(54)

### 5.17 MARJURAM:



**FIG 20:Marjoram**

*Plantago majorana* L. Sweet marjoram is a plant that belongs to the Lamiaceae family (also known as *Majorana hortensis* Moench). This herb is grown throughout several nations and is native to the Mediterranean region.Marjoram tea considerably lowered dehydroepiandrosterone-S (DHEA-S) and proved beneficial in the treatment of polycysticovary syndrome.(55) Because marjoram tea was found to increase insulin sensitivity and lower levels of adrenal androgens, the current study's results demonstrate the favorable effects of marjoram tea on the hormonal profile of PCOS women.(56)

### 5.18 CHASTE TREE:



**FIG 21: Chaste Tree**

In traditional medicine, chaste tree extract—derived from the little flowering *Vitex agnus-castus* tree—has been used to treat a variety of women's health issues, such as infertility, premenstrual stress, and pain during menses(57)IT also helps to enhance fertility and address hormone abnormalities. It did not affect DHEA or estradiol levels, but it did raise progesterone and lower testosterone levels. By aromatizing testosterone to estradiol, the plant extract may also raise the activity of the aromatase enzyme and lower testosterone levels.(58) This plant's extract decreases the symptoms of premenstrual syndrome and corrects high estrogen-dependent hormonal imbalance.(59) The balance and quantity of sex hormones are altered by the *Vitex agnus-castus* extract. Additionally, the plant extract modifies the ratio of estrone to progesterone, which converts estrogen to progesterone.(13)

#### 5.19 FENUGREEK:



**FIG 22: Fenugreek**

The leguminous herb fenugreek, or *Trigonella foenum-graecum*, is grown in North African and Indian nations. It is referred to by several names in different languages and is a member of the Fabaceae family.(60) Clinical research showed that when women took two capsules daily through food, it was successful in reducing the symptoms of PCOS.(61,62) In a similar vein, it also lowers the LH/FSH ratio; oral supplementation was found to significantly maintain the menstrual cycle. These activities suggest that this herb may be beneficial and significant for PCOS(45)

#### 5.20 ANISE:



**FIG 23 :Anise**

Commonly referred to as anise or aniseed, *Pimpinella anisum* L. (*P. anisum*) is an aromatic plant that is mostly found in the Middle East, Asia Minor, and India. It is a member of the Umbelliferae (Apiaceae) family.(63) Aniseed oil mostly consists of trans-anethole (90%) along with anisketone, anisaldehyde, and methyl chavicol.  $\gamma$ -himachalene (2-4%), trans-pseudo isoeugenol 2-methylbutyrate (1.3%), p-anisaldehyde (1%) and methyl chavicol (0.9–1.5%) are other minor compounds found in anisum.(45) Using a rat PCOS model, we evaluated the impact of *P. anisum* as a preventive measure against PCOS damage on these indicators. Numerous studies have indicated that *P. anisum* possesses a great deal of potential as an antioxidant and anti-inflammatory component because it contains phytochemical substances that give the plant its therapeutic qualities, such as flavonoids and trans-anethole(64,65,66)

### 5.21 DATE PALM:



**FIG 24: Date palm**

Date palm contains phytoestrogens, which are molecules with a structure similar to that of estradiol. The macro- and micronutrient content of dates is well recognized. Calcium (Ca), phosphorus (P), strontium (Sr), aluminum (Al), iron (Fe), potassium (K), copper (Cu), magnesium (Mg), manganese (Mn), zinc (Zn), and other minerals are present in it.(67) A component of date palm pollen called phytoestrogen has the ability to act as a mild estrogen antagonist. also has a strong impact when estrogen levels are low, like in PCOS instances. Furthermore, gonadotrophic substances like FSH, which support ovulation and raise this hormone's level, are present in date palm pollen(68)

### 5.22 GARLIC:



**FIG 25: Garlic**

*Allium sativum*, often known as garlic, is a biennial plant that is a member of the Liliaceae family, which has been utilized as a species throughout history. For years, it has been used historically in medical applications. The current research trial evaluated how an 8-week garlic supplementation affected oxidative stress indicators in PCOS patients. The results showed that supplementing with garlic raised body weight, BMI, WC, and glutathione and catalase levels.(69)

#### 5.24 BLACK COHOSH:



**FIG 26: Black Cohosh**

A perennial dicot of the buttercup family, black cohosh is indigenous to Canada and the eastern United States. Other names for it include bugbane, black snakeroot, baneberry, and bug root.(70) *Actaea racemosa* (Ranunculaceae) is used to treat a number of female reproductive system illnesses, including anovulation, infertility, and hormonal balance, all of which are significant problems in PCOS. Women who have polycystic ovarian syndrome (PCOS) can experience ovulation induction through the use of black cohosh.(71) *Actaea Racemosa* was well known as a women's cure for menstruation and pregnancy. Amenorrhoea, leucorrhoea, dysmenorrhoea, and other menstrual and uterine disorders were successfully treated with it.(72)

#### 5.25. GINGER:



**FIG 27:Ginger**

Ginger, or *Zingiber officinale* Roscoe, has been used for centuries as a herbal ingredient in traditional medicine and as a spice in food preparation.(73) Originally from tropical Asia, ginger is now grown all over the world.(74) Additionally, the ginger extract demonstrated potential results in treating PCOS. Female rats with PCOS produced by oestradiol valerate also demonstrated that ginger extract increased the content of LH and oestrogen while decreasing those of progesterone and FSH. This demonstrated the effectiveness of ginger extract in regulating sexual hormones in PCOS.(75) Ginger's therapeutic effects on PCOS are believed to be mediated by a number of different biological mechanisms. Bioactive substances with anti-inflammatory and antioxidant qualities, such as gingerols, shogaols, and gingerdione, are found in ginger. By preventing the NF- $\kappa$ B signalling pathway from being activated, these substances reduce the gene expression of pro-inflammatory cytokines (TNF- $\alpha$ , IL-1 $\beta$ , and IL-6).(76)

#### 5.26 GRAPE SEED:



**FIG 28:Grape seed**

grape seed extract may be useful in treating or preventing PCOS. The metabolic state of PCOS-positive women improved after a brief therapy with grape seed extract.(77) According to the current experiment, women with PCOS may benefit from short-term GSE supplementation. Such a measure could improve their lipid profile, insulin resistance, and serum insulin and fasting blood glucose status.(78)

**5.27 SAW PALMETTO:****FIG 29 :Saw Palmetto**

One of the main symptoms of PCOS, which is brought on by the hormone estrogen being produced in excess, is hirsutism. Because of its antiandrogenic properties, the plant *Serenoa repens* (W. Bartram) Small helps treat hirsutism. It also lowers fat and boosts libido. Hormone balance can be restored by combining *Vitex agnus-castus* L. with *Serenoa repens* (W.Bartram) Small(79)

**5.28 PTEROCARPUS:****FIG 30: Pterocarpus**

Numerous ethnopharmacological characteristics were demonstrated by the genus *Pterocarpus*, and practically every plant part—including the bark, root, leaves, and sap—has been used in traditional medicine to treat a wide range of illnesses.(80)*Pterocarpus marsupium* may be used as an alternative therapy for PCOS treatment after demonstrating possible reproductive effects on female albino rats with PCOS induced by testosterone propionate(81)

**5.29 HEART-LEAVED MOONSEED:****FIG 31:Heart Leaved Moonseed**

Throughout India, *T. cordifolia*, also known as Guduchi, is a big, glabrous, deciduous, climbing shrub with a weak, mushy stem.(82) According to a study, mice's PCOS symptoms were successfully treated by Triphala Churna (TC) satva preparation, which improved: Insulin and blood sugar levels;

lipid profile; hormone balance (progesterone, oestrogen, LH, and FSH); and ovarian health TC may be a medication or supplement for PCOS because of its active ingredients, which include rumphioside-I, berberine, and syringin.(83)

### 5.30 SYMPLOCOS RACEMOSA:



**FIG 32 : Symplocos Racemosa**

*Symplocos racemosa* is a tiny evergreen tree that grows up to 1400 meters in elevation in the plains and hills of northern India and other Asian nations.(85) Menorrhagia and other female reproductive dysfunctions, which are symptoms of PCOS, are treated using *Symplocos racemosa* bark. According to experimental research, *S. racemosa* therapy restored estrogen, progesterone, and cholesterol levels while also considerably lowering increased testosterone levels.(86) Additionally, the ovarian tissue's normal weight and histology were recovered. These *S. racemosa* effects were found to be similar to those of clomiphene citrate.(87,88)

### CONCLUSION:

As PCOS has become a common disorder now-a-days, various herbal ailments showed promising therapeutic effects, in many ways such as by enhancing menstrual cycle, increase of estrogen hormone, by maintaining the hormonal balance etc. so herbs can be preferred for treating various symptoms of PCOS and that also with very less side effects.

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