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# THERAPEUTIC TREATMENT OF POLYCYSTIC OVARIAN SYNDROME (PCOS)

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**Abstract**

Polycystic ovarian syndrome (PCOS) is a complex endocrine hormonal illness that affects one out of every ten women globally and is treated with sophisticated medical treatments that are costly and have several negative effects. Various seed and herbs have traditionally been used to boost women's hormones by providing the nutrients they require at various stages of their hormone cycle. Dietary elements such as n-3 fatty acids, lignans, and fibre may help PCOS patients improve their metabolic abnormalities. We shall learn about alternative successful treatments for PCOS in this review post. At various stages of the female menstrual cycle, flax, fennel, pumpkin, and Fenugreek seed, cinnamon mixtures are employed. Losing weight by eating a fiber-rich diet lowers cholesterol levels while also lowering insulin resistance, which, if left untreated, can lead to type 2 diabetes and its problems. Premenstrual symptoms, hormone changes, and co-morbidities have all been demonstrated to be relieved by various seeds and herbs. This literature evaluation is based on valuable data from Medline/PubMed and Google Scholar up until November 2022.

**Keywords**
Polycystic Ovarian Syndrome (PCOS), Hormone Cycle, Premenstrual Symptoms, Dietary Management, Cinnamon, Fenugreek Seed

## 1. Introduction

PCOS is an underlying hormonal condition that affects one out of every ten women globally. Increased testosterone levels, acne, and excessive hair growth are all symptoms of PCOS. Insulin resistance, anovulation, and infertility are all possible side effects. 1. PCOS women have a higher prevalence of CVD

illnesses, such as high blood pressure, dyslipidemia, and type 2 diabetes, as well as non-traditional CVD risk factors, such as mood disorders including sadness and anxiety. 2. PCOS women, according to endocrinologists and gynaecologists, are at an elevated risk of obstetric, metabolic abnormalities, hematological malignancies, and psychiatric issues through their lives3. PCOS is a treatable condition that may be treated with either natural or allopathic medicines. An attempt has been made in this review to investigate the usage of natural remedies for the treatment of PCOs (Goswami *et al.,* 2012, Palomba *et al.,* 2015, Rocca *et al.,* 2015, Khani *et al.,* 2021)

### *1.1 Prevalence of PCOS*

Polycystic ovarian syndrome (PCOS) affects 4–8% of women globally, per the World Health (WHO). As per the Indian Council of Medical Research (Krishnan A & Muthusami S, 2017), 12.2 percent of Indian teenagers have PCOS. In the United States, PCOS affects about 5 million females of reproductive age (Haq *et al.,* 2017). South Asian women, particularly Pakistani women, have a substantially greater frequency of PCOS (52%) than the white population (20-25%) in the UK (Azhar *et al.,* 2020). In Pakistan, infertility affects 21.9 percent of couples (Memon *et al.,* 2020).

### *1.2 Alternative treatment for PCOS*

Herbal medicines and treatments are becoming a popular new treatment option for polycystic ovarian syndrome (PCOS) symptoms and problems like obesity, irregular periods, and hirsutism, among others (Khanage *et al.,* 2019). In the fields of nutrition and eastern medicine, several seeds and spices are utilised to alleviate the symptoms of PCOS (Ahmad &Safuan, 2019).

Flaxseed is a therapeutic plant that grows in over fifty places across the world. Lipids, proteins, lignans, fibres, and minerals are the main components of flaxseed (Ebrahimi *et al.,* 2011). It contains antioxidants including tocopherols, beta-carotene, cysteine, and methionine, which help to lower blood pressure, cardiovascular disease, hepatic and neurological problems, and improve insulin sensitivity (Nowak *et al.,* 2007).

#### 1.2.1. Fenugreek Seeds

They are one of the most promising medicinal herbs, containing alkaloid, flavonoids, saponin, and volatile compounds (Fatima *et al.,* 2018), as well as macro and micro nutrients. It has a high concentration of anti-diabetic, anti-carcinogenic, hypocholesterolemic, antioxidant, and immunological characteristics (Wani & Kumar, 2018).

#### 1.2.2 Pumpkin Seeds

They have diverse biological activities and contains high nutrient content and famous for anti-diabetes, anti-inflammation and anti-cancer properties (Dong *et al.,* 2020).

#### 1.2.3. Fennel Seeds

They have been recognized as therapeutic herb from prehistoric times. Recent researches have revealed so many medicinal and pharmacological properties of fennel seeds as

antimicrobials, antidiabetic, antioxidants, anticancer (Mehra *et al.,* 2021).

### 1.2.4. Cinnamon Powder

Cinnamon powder and extract have the ability to alleviate insulin resistance by stimulating phosphatidylinositol 3-kinase activity in the expression and function, allowing insulin action to be maintained (Dou *et al.,* 2018). Cinnamon is a flavouring spice that has been demonstrated to have anti-PCOS and anti-diabetic properties (Dou *et al.,* 2018).

**Table 1:** Herbs and Spices used for management of PCOS

| Sr. No | Name | Scientific Name | Form Used | Compound Present | Reference |
|---|---|---|---|---|---|
| 1 | Flaxseed | *Linum usitatissimum* | Powder, hydroalcoholic extract, oil | Phytoestrogen | (Kiczorowska *et al.,* 2019) |
| 2 | Fenugreek Seeds | *Trigonella foenum-graecum* | Aqueous extract, powder | Furocyst | (Salehi *et al.,* 2019) |
| 3 | Pumpkin Seeds | *Cucurbita maxima* | hydroalcoholic extract, powder | Packed with monounsaturated fats, protein, vitamin A and B, beta-sitosterol | (Akomolafe *et al.,* 2021) |
| 4 | Fennel Seeds | *Foeniculum vulgare* | Oil, powder | Anethole | (Kalleli *et al.,* 2019) |
| 5 | Cinnamon | *Cinnamomum verum* | Extract, powder | Cinnamaldehyde | (Mishra *et al.,* 2022) |

## 2. Experimental Studied Of Fenugreek Seeds

Trigonellafoenum-graecum (fenugreek), a legumes that has been used as a spice to improve the sensory quality of meals all over the world, is thought to have a high nutraceutical value. Trigonella seeds are thought to have anti-diabetic property because of the presence of steroid saponins, alkaloids, and fibre. The HPLC technique was used to detect and quantify five bioactive compounds: trigonelline, isoorientin, orientin, vitexin, and isovitexin. The high-performance liquid chromatography hybrid electrospray quadrupole time-of-flight mass spectrometric (HPLC-ESI-QTOF-MS/MS) approach was used to detect bioactive chemicals much faster. On the basis of their retention duration and mass, twenty-five substances were successfully detected. To deduce the structures of known substances, fragmentation patterns were used. Six of the identified compounds, namely 4-hydroxyisoleucine, trigonelline, isoorientin, isovitexin, pinitol, and sarsasapogenin, were quantified simultaneously using an ultrahigh-performance liquid chromatography hybrid electrospray triple quadrupole linear ion trap mass spectrometer in the multiple reactions monitoring (MRM) mode. The analytical approach was verified and

successfully used to the simultaneous determination of chemicals in Fenugreek seeds, demonstrating the technology's appropriateness for quality control (Singh *et al.,* 2022).

Seeds of fenugreek have antiandrogenic and anti-hyperglycemic properties. The purpose of this study was to see if an extracts of fenugreek seed may help rats with Polycystic Ovary Syndrome. There have been 24 female Wistar rats divided into two groups of ten rats each. Group 1 received saline (0.9 percent NaCl), whereas Group 2 underwent PCOS treatment. The PCOS-affected rats were split into two groups. The extracts of fenugreek seeds and metformin (300mg/Kg) were given to each group for 21 days, whereas the control group was given saline. Insulin, testosterone, and lipid profile were all determined. In Letrozole-treated rats, there was a notable change in testosterone levels, insulin action, glucose, and lipid profile ($P<0.001$). The estrus cycle was also found to be acyclic with cysts. Recovery of normal ovarian stroma, normalisation of estrous cycle, and lower testosterone levels, insulin, glucose, and lipids were seen in the Fenugreek and metformin categories. These data imply that aqueous fenugreek extract improved the management of insulin sensitivity, hyperandrogenaemia, and ovarian abnormalities in PCOS patients (Manzoor *et al.,* 2021).

A two-month trial was done to compare the therapeutic effects of fenugreek and flaxseed, as well as the usage of both together to treatment PCOS in female rats. There have been 40 rats divided into four groups, each with eight rats. Group 1 acted as a control group, whereas Group 2 was given Estradiol valerate (4mg per kg in 0.4ml Sesame oil) to treat PCOS. Fenugreek aqueous extract (100 mg per kg), flaxseed aqueous extract (300 ml per kg), and a mixture of both extracts were given to Groups 3 and 4. The Estradiol Valerate caused a spike in sugar, insulin, insulin resistance, lipid profile, aspartate aminotransferase (AST), alanine aminotransferase (ALT), and gamma-glutamyltranspeptidase, according to the findings (GGT). Furthermore, estradiol caused a significant increase in serum LH, FSH, testosterone, and a reduction in progesterone. In addition, a considerable spike in lipid peroxidation resulted in a negligible increase in NO and a significant decrease in superoxide dismutase. Fenugreek and flaxseed supplementation considerably lowered these values. The findings revealed both fenugreek and flaxseed had a beneficial effect on insulin receptor dysfunction and hyperandrogenism in PCOS (Osman *et al.,* 2019).

## 3. Experimental Studied of Flaxseeds

An interventional study was undertaken on 32 PCOS patients to evaluate how flax seed powder affected their ovarian morphology, menstrual cycle, hirsutism, and blood sugar levels. At the outset of the trial, menstruation histories, BMI, random sugar levels, ultrasonography abdomen, and FerrimanGalleway hirsutism rating were all completed. For three months, 15g flax powder in milk were administered. For three months, the

above variables were tested once a month. For data analysis, the paired - samples t test was used. Flax seed therapy resulted in significant reductions in mean ovary size and number of follicles. The average loss in right and left ovarian volume were -3.35 c.mm and -2.383 c.mm, respectively, and the average difference in follicle number was -4.259, -4.519 for right and left ovaries (p value 0.01). 17 (56.7%) of the individuals had no peripheral follicles after flax seed treatment, while 16 (53.3%) had ovarian echogenicity. 12 of the subjects (40%) had a better menstrual cycle, and three of them (10%) became pregnant. After treatment, there was no discernible difference in hirsutism or blood sugar levels (Farzana *et al.,* 2015).

The goal of this randomised double-blind, placebo-controlled trial was to see how omega-3 fatty acids and vitamin E supplementation affected lipoprotein and oxidised LDL gene expression, lipid profiles, and oxidative stress biomarkers in individuals with polycystic ovarian syndrome. 68 PCOS women between the ages of 18 and 40 were randomly assigned to one of two groups. For 12 weeks, each group was given 1000 mg omega-3 fatty acids from flaxseed oil with 400 mg -Linolenic acid and 400 IU vitamin E supplements. RT-PCR was used to measure lipoprotein and oxidized-LDL mRNA levels in PCOS women's blood mononuclear cells. At the beginning and end of the trial, lipid profiles and oxidative stress indicators were measured. When compared to the control, omega-3 fatty acids and vitamin E co-supplementation in blood mononuclear cells of women with PCOS decreased expression levels of Lipoprotein mRNA (P 0.001) and Ox-LDL mRNA (P 0.001). Omega-3 fatty acids and vitamin E co-supplementation also resulted in a substantial reduction in serum triglycerides, VLDL, LDL, and total HDL-cholesterol when compared to the placebo group. The researchers found that supplementing PCOS women with omega-3 fatty acids and vitamin E for 12 weeks increased expression of genes of hdl and oxidized-LDL, lipid profiles, and oxidative stress indicators (Rahmani *et al.,* 2017).

Yousif and his colleagues carried the research to see how flaxseed powder supplementation affected the hormonal profiles and genome concentrations of Karadi male lambs. Twelve six-month-old lambs were placed into three groups. Each group had four lambs, and the trial lasted eight weeks. In their feed, the control group received 0% flaxseed, 4% flaxseed at a reduced level (T1), and 8% flaxseed at a high level (T2). Every two weeks, blood samples were taken from each ram lamb, serum was separated right away, and testosterone, estrogen, (GH), (TSH), and (T4) were analyzed. Each sample's genomic DNA was extracted. In comparison to the control group, testosterone hormone levels reduced considerably in the T2 group. T1 had a considerably higher level of estradiol hormone than control and T2, respectively. Flaxseed had a substantial favourable influence on growth hormone, with levels rising in the T2 group compared to the T1

group. TSH levels increased significantly in the T1 and T2 groups compared to the control group, while the T4 hormone was unaffected. In comparison to the control group, flaxseed supplementation resulted in a substantial drop in Genomic DNA concentrations in the T2 group. In summation, adding flaxseed to lamb rations resulted in a large decrease in testosterone, an increase in estradiol concentration, and a significant increase in each of the female hormones and TSH hormones, while T4 was unaffected (Yousif, 2019).

Nutraceutical Interventions of Seed in the Management of Poly Cystic Ovary Syndrome was the subject of a systematic review. According to the study, PCOS is most common in developing nations like India and Pakistan. Multiple cysts can be found in the female ovaries of people with PCOS. PCOS symptoms include irregular menstrual cycles, hypothyroidism, acne, mood swings, and androgen imbalances, as well as elevated insulin levels. Seed cycling is beneficial in the therapy of PCOS, according to this review article. They looked at flax, sesame, pumpkin, and sunflower seeds, as well as their mixtures, at various times of the female menstrual cycle. Flaxseeds are high in lignans, omega 3 fatty acids, and fibre, all of which can help in PCOS treatment. Sunflower and sesame seeds have a large amount of fatty and lignans, which aid in the maintenance of hormonal imbalances in women. Losing weight by eating a high-fiber diet lowers cholesterol levels and aids in the reduction of IR, which, if left untreated, can lead to type two diabetes. Ayurvedic herbal medicine has demonstrated promise in alleviating premenstrual symptoms, hormonal fluxes, and co-morbidities (Aslam *et al.,* 2021).

In such a PCOS-induced rat model, Jelodar G and his colleagues investigated the effect of flaxseed hydroalcoholic extract on ovarian hormones as well as histologic alterations in the uterus and ovary. Four groups of 24 rats were formed. I was in charge of the control group. For 30 days, Group II was given a flaxseed hydroalcoholic extract. A single intramuscular dose of estradiol valerate was used to induce Group III. For 30 days, Group IV was given flaxseed extract 7 following weeks induction of PCOS. Ovaries and uterine sections were dissected and used for histomorphometric analysis. The serum was tested for estradiol, progesterone, testosterone, and dehydroepiandrosterone (DHEA). In comparison to Group III, flaxseed extract boosted progesterone levels (P0.05) while decreasing testosterone levels (P0.05). In comparison to group III, oestrogen and DHEA concentrations did not vary appreciably. The frequency of preantral follicles, antral follicles, and corpus luteum rose in group IV compared to group III (P0.05), but the amount of cystic follicles and antral follicle diameter decreased (P0.05), and the amount of primary follicles did not change substantially. The hydroalcoholic extract of flaxseed improved the hormone profile and histomorphometric aspects of the ovary, which

were altered by PCOS induction (Jelodar *et al.*, 2018).

It was a clinical study in which 41 PCOS patients were chosen to explore how flaxseed powder supplementation affected metabolic parameters. For twelve weeks, the participants were randomly assigned to take flaxseed powder 30 g per day with lifestyle changes or only lifestyle modification. At the outset and end of the trial, all PCOS patients had their anthropometric and biochemical measurements taken. When compared to the baseline, the flaxseed group showed a significant decrease in BMI, insulin intensity, Homoeostasis Model Assessment of Insulin Sensitivity, Triglycerides, high-sensitivity C-Reactive Protein, and leptin, as well as an increase in Comparative Insulin-Sensitivity Review Index, HDL, and adiponectin. When compared to the control group, flaxseed supplementation resulted in a substantial decrease in levels of insulin, HOMA-IR, TG, hs-CRP, Interleukin 6 (IL- 6), and leptin, as well as an improvement in Quantitative Insulin-Sensitivity Check Index, HDL, and adiponectin (p 0.05). Other parameters did not show any significant changes (Haidari & Banaei-Jahromi, 2020).

Spearmint, Mentha spicata L., has anti-androgenic qualities, and flaxseed contains phytoestrogen, which helps to alleviate PCOS symptoms. The goal of this research was to find the right combination of spearmint and flaxseed extract that enhanced the ovary's endocrine and histomorphology in experimental PCOS. Group 1 consisted of 24 rats split into 4 groups (Control group). Group 2 (got a mixture of spearmint extract and flaxseed extracts for 30 days), Group 3, and Treatment 4 (provided a mixture of spearmint extract and flaxseed extract for 30 days). PCOS and therapy (T) groups received estradiol valerate injections. Estrous cycles were tracked for ten days. Ovaries were collected for histomorphometry and serum concentrations of progesterone, testosterone, estradiol, and dehydroepiandrosterone (DHEA) was assessed at the end of the trial. When compared to the PCOS group, the T group reported an increase in progesterone and a reduction in testosterone and estradiol, with no significant change in DHEA (P 0.05). There was no significant difference in the assessed hormones between the T and control groups (C & CT). When compared to the PCOS group, the frequency of cystic follicles reduced in the T group. When comparing the T category to the PCOS group, the diameter of the granulosa layer increased whereas the width of the theca reduced significantly (P 0.05) (Mehraban *et al* 2020).

To analyze the impact of flaxseed oil omega-3 fatty acids administration on the metabolic condition of patients with polycystic ovarian syndrome, a randomised double-blind, placebo-controlled experiment was undertaken on 60 women with PCOS aged 18–40 years. They were divided into two groups at random. For three months, each group (n=30) received 1,000 mg flaxseed oil omega-3 fatty acids (n=30) and placebo (n=30). At the beginning and end of the

study, metabolic, endocrine, and inflammatory variables were measured. Flaxseed oil omega-3 supplements reduced significantly insulin values, homeostasis models of evaluation insulin resistance, mF-G scores, and raised quantitative glycaemic control check index after the 12-week intervention compared to the placebo. Furthermore, as compared to the placebo, flaxseed oil omega-3 supplementation resulted in significant reductions in blood triglycerides, low density lipoprotein cholesterol, and high-sensitivity C-reactive protein (Mirmasoumi *et al* 2018).

The focus of this research was to see if bioactive compounds present in flaxseed powder could help with PCOS symptoms and problems, as well as rebalancing hormone levels in the body, treating insulin resistance, and maintaining BMI. Thirty women with PCOS, ranging in age from 18 to 40, were chosen and divided into three groups for three months. Excluding metformin capsules, all groups were instructed to follow a low-carbohydrate, low-protein diet in addition to getting the base drugs to maintain or lose weight. According to the findings, ground flaxseed, in combination with a low-carbohydrate, low-protein diet, has a substantial positive impact in treating symptoms of PCOS, addressing hormonal imbalances, regulating the menstrual cycle, and preventing pregnancy and parenthood in some women (Matar *et al* 2019).

The effect of 30 grammes of flaxseed supplementation per day on hormone levels was investigated in a clinical case study. Women with PCOS who were 31 years old were chosen. The patient consumed 83 percent of the flaxseed dose during the four-month study. At baseline, heights, weights, and fasting blood samples were taken, and the following values were discovered after a 4-month follow-up: Total serum testosterone (150 ng/dl vs. 45 ng/dl); free serum testosterone (4.7 ng/dl vs. 0.5 ng/dl); and percent free testosterone (3.1 percent vs. 1.1 percent ). At the end of the research, the patient reported a decrease in hirsutism. The clinically substantial drop in androgen levels described in this case study, together with a decrease in hirsutism, highlights the need for more investigation into the effects of flaxseed supplement on hormone balance and PCOS clinical symptoms (Nowak *et al* 2007).

**Table 2:** Experimental Studies of Cinnamon

| Sr.No | Title | Study Design | Participants | Interventions | Duration | Results | References |
|---|---|---|---|---|---|---|---|
| 1 | Effects of cinnamon supplementation on antioxidant status and serum lipids in women with polycystic | Clinical Trial | 84 overweight or obese PCOS Women | 3 cinnamon capsules 500 mg each | 8 weeks | ↑serum total antioxidant capacity (P = 0.005) ↓ Malondialdehyde, Improved serum level of total cholesterol, LDL, HDL | (Borzoei et al., 2018) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | ovary syndrome | | | | | | |
| 2 | Combined Lifestyle and Herbal Medicine in Overweight Women with Polycystic Ovary Syndrome (PCOS): A Randomized Controlled Trial | pragmatic, randomized controlled trial | 18–44 years with PCOS women | Lifestyle interventions + Tablet 1 contained Cinnamomum verum, Glycyrrhiza glabra, Hypericum perforatum and Paeonia lactiflora. Tablet 2 contained Tribulus terrestris. | 3 months | ↓Oligomenorrhoea lifestyle group compared with lifestyle alone P < 0.01). ↓ BMI (P < 0.01);↓Waist circumference (P < 0.01);↓ insulin (P = 0.02), and ↓ LH (P = 0.04);↓Bp (P = 0.01); improvement in the quality of life and pregnancy rates (P = 0.01) in combination group compared with lifestyle intervention alone. | (Arentz et al., 2017) |
| 3 | Insulin resistance improvement by cinnamon powder in polycystic ovary syndrome: A randomized double-blind placebo controlled clinical trial | randomized double-blind placebo controlled clinical trial | 66 PCOS Women | cinnamon powder capsules 1.5 g/day | 12 weeks | ↓Fasting insulin ($p$ = .024) and homeostatic model assessment for insulin resistance ($p$ = .014), ↓ in LDL in cinnamon group ($p$ = .004) as compared with baseline | (Hajimonfarednejad et al., 2018) |
| 4 | Preliminary evidence that cinnamon improves menstrual cyclicity in women with polycystic ovary syndrome: a randomized controlled trial | placebo controlled, double-blinded randomized trial | 45 PCOS Women | cinnamon supplements (1.5 g/d) | 6 months | improves menstrual cyclicity | (Kort & Lobo, 2014) |
| 5 | Cinnamon improves metabolic factors without detectable | double-blind randomized controlled clinical | 84 overweight or obese PCOS Women | cinnamon capsules (each one contained 500 mg cinnamon) | 8 Weeks | ↓ serum fasting blood glucose, insulin, homeostatic model assessment for insulin | (Borzoei et al., 2018) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | effects on adiponectin in women with polycystic ovary syndrome | trial | | | | resistance, total cholesterol and LDL cholesterol, weight. ↓Serum triglyceride and BMI in the cinnamon group, in comparison with baseline values | |

## 4. Experimental Studied of Pumpkin Seeds

Motamed-Jahromi and his colleagues conducted a study to see how a hydro-alcoholic extract of pumpkin seeds affected the amount of oestrogen hormone in adult female rats, as well as the effects on liver indicators and alterations in liver and ovarian tissue. A total of 40 immature female rats weighing 10180 g were split into five groups. There are eight rats in each group. There were three experimental groups, as well as control and sham groups. The experimental groups were given a hydro-alcoholic extract of pumpkin seeds intraperitoneally for 21 days. Hepatic and ovarian markers were measured in the blood, and histological examinations of the liver and ovaries were performed. In experimental group 3, there was a significant decrease in ALP and a significant increase in FSH and LH, as well as a considerable decrease in the amount of primary and primary follicles in the three treatment conditions compared to the Controlling group, and the number of secondary follicles in the experimental class 1 compared to the experimental groups 2 and 3 ($P>0.05$) (Motamed-Jahromi *et al* 2019).

The effect of herbal plants for the treatment of Polycystic Ovary Syndrome was investigated in a review study. This report covers all PCOS and herbal research published between 1990 and 2019. A total of 361 articles were found. After screening, 323 studies were eliminated, leaving 38 publications to be considered. The findings revealed that several medicinal herbs may play an important role in the treatment of PCOS (Ashkar *et al* 2019).

## 5. Experimental Studied of Fennel Seeds

To examine and assess the efficacy of fennel essential oil capsules on PCOS symptoms, researchers conducted a double-blinded, randomised controlled trial. 30 ladies between the ages of 20 and 35 were randomly assigned to one of two groups: Control or Fennel. Before and after the groups received therapy, the ultrasonography evaluations, BMI, biochemistry, and hirsutism variables were all examined separately. To compare two groups statistically, the Man-Whitney and chi-square tests were used. The results showed that interventions had no significant differences between the two groups, except for

dehydroepiandrosterone sulphate (DHEAS) levels and the number of ovarian follicles (p 0.05). Fennel was not successful in reducing PCOS symptoms, and it's possible that this is because the sample size calculation in this short trial was predicated on extremely large effect sizes, and the study wasn't powered enough to detect lesser effects (Ghavi *et al* 2019).

The goal of this study was to see how the chitosan-fennel seed extract system affected hormonal and biochemical parameters in polycystic ovarian syndrome. In female rats, estradiol valerate-induced PCOS was proven. Fennel seed extract was used to treat PCOS-affected rats. After 16 days of treatment, serum serum concentrations, LH, follicle-stimulating hormone, insulin, glucose, HDL cholesterol, TC, and total triglycerides were measured and compared to healthy controls and untreated PCOS-control groups. In rats with PCOS, the treatment contributed to outstanding hormonal, glucose, and lipid profile control (Bayrami *et al* 2019).

## 6. Conclusion

According to the review paper, based on current clinical evidence, several medicinal plants, including flaxseeds, fenugreek seeds, fennel seeds, pumpkin seeds, and cinnamon herbs, have a promising role in the treatment and management of PCOS, showing a slow and steady effect with minimal side effects. It boosts the body's immunity and helps to regulate the menstrual cycle without causing hormonal imbalances, but regular use may help to treat the problem at its source. They have positive impacts on various aspects of PCOS, but they have certain drawbacks, such as limited sample sizes and short study durations. To examine their mechanisms and safety, more preclinical and clinical research with a bigger sample size and a more systematic methodology are required.

## 7. References

Ahmad F, Safuan S. (2019). Assessing the effectiveness of plant extracts in polycystic ovarian syndrome: a systematic review. Malaysian Journal of Medicine and Health Sciences. 15(2):120-9.

Akomolafe SF, Olasehinde TA, Aluko BT. (2021) Diets supplemented with raw and roasted pumpkin (Cucurbita pepo L) seeds improved some biochemical parameters associated with erectile function in rats. Journal of Food Biochemistry. 45(2):e13629.

Arentz S, Smith CA, Abbott J, Fahey P, Cheema BS, Bensoussan A.(2017).Combined lifestyle and herbal medicine in overweight women with polycystic ovary syndrome (PCOS): A randomized controlled trial. Phytotherapy research. 31(9):1330-40.

Ashkar F, Rezaei S, Salahshoornezhad S, Vahid F, Gholamalizadeh M, Dahka SM et al., (2019). The Role of medicinal herbs in treatment of insulin resistance in patients with Polycystic Ovary Syndrome: A literature review. Biomolecular concepts. 11(1):57-75.

Aslam M, Shauket R, Yousaf Z, Tehzeeb K. (2021). Nutraceutical Intervention of Seeds in the Treatment of Poly Cystic Ovarian Syndrome; A Systematic

Review: Nutraceutical Intervention; Seed Cycling. Pakistan BioMedical Journal. ;4(2).

Azhar A, Abid F, Rehman R. (2020). Polycystic Ovary Syndrome, Subfertility and Vitamin D Deficiency. J Coll Physicians Surg Pak. 30(5):545-6.

Bayrami A, Shirdel A, Pouran SR, Mahmoudi F, Habibi-Yangjeh A, Singh R et al. (2020). Co-regulative effects of chitosan-fennel seed extract system on the hormonal and biochemical factors involved in the polycystic ovarian syndrome. Materials Science and Engineering: C. 117:111351.

Borzoei A, Rafraf M, Niromanesh S, Farzadi L, Narimani F, Doostan F. (2018). Effects of cinnamon supplementation on antioxidant status and serum lipids in women with polycystic ovary syndrome. Journal of traditional and complementary medicine. 8(1):128-33.

Dong XJ, Chen JY, Chen SF, Li Y, Zhao XJ. (2021). The composition and anti-inflammatory properties of pumpkin seeds. Journal of Food Measurement and Characterization. 15(2):1834-42.

Dou L, Zheng Y, Li L, Gui X, Chen Y, Yu M, Guo Y. (2018). The effect of cinnamon on polycystic ovary syndrome in a mouse model. Reproductive Biology and Endocrinology. 16(1):1-0.

Ebrahimi B, Nazmara Z, Hassanzadeh N, Yarahmadi A, Ghaffari N, Hassani F et al., (2021). Biomedical features of flaxseed against different pathologic situations: A narrative review. Iranian Journal of Basic Medical Sciences. 2021 May;24(5):551.

Farzana F, Sulaiman A, Ruckmani A, Vijayalakshmi K, Karunya Lakshmi G, Shri Ranjini S. (2015). Effects of flax seeds supplementation in polycystic ovarian syndrome. Int J Pharm Sci Rev Res. 31(1):113-9.

Fatima T, Maqbool K, Hussain SZ. (2018). Potential health benefits of fenugreek. Journal of Medicinal Plants Studies. 6(2):166-9.Ghavi F, Taghizadeh M, Taebi M, Abdolahian S. Effect of Foeniculum vulgare essence on symptoms of polycystic ovarian syndrome (PCOS): a randomized double-blind, Placebo-Controlled Trial. Journal of Herbal Medicine. 2019 Sep 1;17:100-277.

Goswami PK, Khale A, Ogale S. (2012). Natural remedies for polycystic ovarian syndrome (PCOS): a review. International journal of pharmaceutical and phytopharmacological research. 1(6):396-402.

Haidari F, Banaei-Jahromi N, Zakerkish M, Ahmadi K. (2020). The effects of flaxseed supplementation on metabolic status in women with polycystic ovary syndrome: A randomized open-labeled controlled clinical trial. Nutrition journal. 19(1):1-1.

Hajimonfarednejad M, Nimrouzi M, Heydari M, Zarshenas MM, Raee MJ, Jahromi BN. (2018). Insulin resistance improvement by cinnamon powder in polycystic ovary syndrome: A randomized double- blind placebo controlled clinical trial. Phytotherapy Research. 32(2):276-83.

Haq N, Khan Z, Riaz S, Nasim A, Shahwani R, Tahir M. (2017). Prevalence and knowledge of polycystic ovary syndrome (PCOS) among female

science students of different public Universities of Quetta, Pakistan. Imperial Journal of Interdisciplinary Research. 35(6):385-92.

Jelodar G, Masoomi S, Rahmanifar F. (2018). Hydroalcoholic extract of flaxseed improves polycystic ovary syndrome in a rat model. Iranian journal of basic medical sciences.21(6):645.

Kalleli F, Bettaieb Rebey I, Wannes WA, Boughalleb F, Hammami M, Saidani Tounsi M et al., (2019). Chemical composition and antioxidant potential of essential oil and methanol extract from Tunisian and French fennel (Foeniculum vulgare Mill.) seeds. Journal of food biochemistry. 2019 Aug;43(8):e12935.

Kiczorowska B, Samolińska W, Andrejko D, Kiczorowski P, Antoszkiewicz Z, Zając M et al., (2019). Comparative analysis of selected bioactive components (fatty acids, tocopherols, xanthophyll, lycopene, phenols) and basic nutrients in raw and thermally processed camelina, sunflower, and flax seeds (Camelina sativa L. Crantz, Helianthus L., and Linum L.). Journal of Food Science and Technology. 2019 Sep;56(9):4296-310.

Khanage SG, Subhash TY, Bhaiyyasaheb IR. (2019). Herbal drugs for the treatment of Polycystic ovary syndrome (PCOS) and its complications. Pharmaceutical Research. 2(1):5-13.

Khani S, Abdollahi M, Khalaj A, Heidari H, Zohali S. (2021). The effect of hydroalcoholic extract of Nigella Sativa seed on dehydroepiandrosterone-induced polycystic ovarian syndrome in rats: An experimental study. International Journal of Reproductive BioMedicine. 19(3):271.

Krishnan A, Muthusami S. (2017). Hormonal alterations in PCOS and its influence on bone metabolism. Journal of Endocrinology. 232(2): R99-113.

Manzoor Lodhi B, Firdous U. (2021). The effect of fenugreek seeds (Trigonella foenum-Gracecum) supplementation on glycemic status, androgens, and lipid profile in letrozole induced polycystic ovarian syndrome (PCOS) model. BioSight. 2021 Dec 31;2(2):13-21.

Matar SS, Farrag AA, Hafez SM, Fahmy RM. (2019). The Bioactive Effect of Flaxseed on Women with the Polycystic Ovarian Syndrome.

Mehra N, Tamta G, Nand V. (2021). A review on nutritional value, phytochemical and pharmacological attributes of Foeniculum vulgare Mill. Journal of Pharmacognosy and Phytochemistry. 10(2):1255-63.

Mehraban M, Jelodar G, Rahmanifar F. (2020). A combination of spearmint and flaxseed extract improved endocrine and histomorphology of ovary in experimental PCOS. Journal of ovarian research. 13(1):1-8.

Memon TF, Channar M, Shah SA, Shaikh A. (2020). Polycystic ovary syndrome: risk factors and associated features among university students in Pakistan. Journal of Peoples University of Medical & Health Sciences Nawabshah.(JPUMHS). 10(1).

Mishra N, Srivastava R. (2022). Therapeutic and Pharmaceutical Potential of Cinnamon. InResearch Anthology on Recent Advancements in Ethnopharmacology and Nutraceuticals (pp. 698-710). IGI Global.

Mirmasoumi G, Fazilati M, Foroozanfard F, Vahedpoor Z, Mahmoodi S, Taghizadeh M et al., (2018). The effects of flaxseed oil omega-3 fatty acids supplementation on metabolic status of patients with polycystic ovary syndrome: a randomized, double-blind, placebo-controlled trial. Experimental and Clinical Endocrinology & Diabetes. 126(04):222-8.

Motamed-Jahromi S, Niami-Jahromi S. (2019). Effect of hydro-alcoholic extract of pumpkin seeds on estrogen hormone and liver markers in adult female rats. KAUMS Journal (FEYZ). 23(5):455-66.

Nowak DA, Snyder DC, Brown AJ, Demark-Wahnefried W. (2007). The effect of flaxseed supplementation on hormonal levels associated with polycystic ovarian syndrome: A case study. Current topics in nutraceutical research. 5(4):177.

Osman NN, Alsahfi SA, Alshubaily F. (2019). Effectiveness of Aqueous Extract of Fenugreek Seeds and Flaxseed on Polycystic Ovarian Syndrome in Female Rats. Int. J. Pharm. Res. Allied Sci. 8(4):42-54.

Palomba S, Santagni S, Falbo A, La Sala GB. (2015). Complications and challenges associated with polycystic ovary syndrome: current perspectives. International journal of women's health. 7:7-45.

Rahmani E, Samimi M, Ebrahimi FA, Foroozanfard F, Ahmadi S, Rahimi M et al., (2017). The effects of omega-3 fatty acids and vitamin E co-supplementation on gene expression of lipoprotein (a) and oxidized low-density lipoprotein, lipid profiles and biomarkers of oxidative stress in patients with polycystic ovary syndrome. Molecular and cellular endocrinology. 39:247-55.

Rocca ML, Venturella R, Mocciaro R, Di Cello A, Sacchinelli A, Russo V et al., (2015). Polycystic ovary syndrome: chemical pharmacotherapy. Expert Opinion on Pharmacotherapy. 16(9):1369-93.

Salehi A, Fallah S, Zitterl-Eglseer K, Kaul HP, Abbasi Surki A, Mehdi B. (2019). Effect of organic fertilizers on antioxidant activity and bioactive compounds of fenugreek seeds in intercropped systems with buckwheat. Agronomy. 9(7):367.

Singh P, Bajpai V, Gond V, Kumar A, Tadigoppula N, Kumar B. (2020). Determination of bioactive compounds of fenugreek (Trigonella foenum-graecum) seeds using LC-MS techniques. InLegume Genomics (pp. 377-393). Humana, New York, NY.

Wani SA, Kumar P. (2018). Fenugreek: A review on its nutraceutical properties and utilization in various food products. Journal of the Saudi Society of Agricultural Sciences. 17(2):97-106.

Yousif AN. (2019). Effect of Flaxseed on some hormonal profile and genomic DNA concentration in Karadi lambs. InIOP Conference Series: Earth and Environmental Science (Vol. 388, No. 1, p. 012035). IOP Publishing.