

Review

# A Natural Approach to Fertility Improvement: A Comprehensive Research with a Focus on Herbal Medicine.

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## Abstract

Infertility, defined as the inability to conceive after one year of regular unprotected intercourse, affects millions of couples worldwide. With multifaceted causes encompassing both female and male factors, infertility deeply impacts individual, family, and social life, in addition to contributing to population ageing. Conventional treatments, such as medication and assisted reproductive techniques, are not always effective or accessible, which drives the search for complementary alternatives, including medicinal plants.

This study aims to analyse fertility and infertility, describe conventional treatments and their limitations, and present a review of the scientific literature on the application of plant-based products in the area of fertility. A comprehensive review of observational studies, clinical trials, and meta-analyses was conducted, focusing on medicinal plants used for female and male fertility and their mechanisms of action.

The literature review revealed that several medicinal plants have been traditionally used to support fertility, with growing scientific evidence corroborating their potential benefits. In female fertility, plants such as *Cuscuta chinensis*, *Angelica gigas*, *Cyperus rotundus*, and *Trifolium pratense* demonstrated positive effects on hormonal regulation, endometrial receptivity, and oxidative stress reduction. In male fertility, plants such as *Mucuna pruriens*, *Withania somnifera*, *Eurycoma longifolia*, and *Panax ginseng* showed promising results in improving sperm quality, hormone levels, and overall reproductive function. Other medicinal plants have also shown potential, suggesting a broader spectrum of natural interventions that may complement conventional therapies.

The results suggest that medicinal plants may represent a promising complementary approach for treating infertility, offering a natural and potentially less invasive option. However, their use should be guided by qualified health professionals, and further rigorous clinical research is essential to validate efficacy and safety.

**Keywords:** Fertility; Infertility; Reproductive health; Herbal medicine; Medicinal plants.

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## 1. Introduction

Reproduction, a fundamental biological process for species perpetuation, depends on the complex interaction between the male and female reproductive systems. This interaction defines fertility—the ability to produce offspring—and influences the characteristics and behaviours of each sex <sup>1</sup>.

Infertility is defined as the inability to conceive after one year or more of regular, unprotected sexual intercourse. This condition affects both men and women and can have

multiple causes, both female and male <sup>2-4</sup>. Infertility affects approximately one in six couples worldwide <sup>5</sup>, potentially having a significant emotional and social impact <sup>6-9</sup>.

Infertility affects about 30% of couples in certain regions of the world, such as South Asia, Central and Eastern Europe, and in countries of Sub-Saharan Africa, the Middle East, and North Africa <sup>10</sup>. The study by Tamrakar *et al.* <sup>11</sup> reveals that among infertile couples, 48.8% of cases involve only female factors, 10.1% only male factors, 26.6% both factors, and 14.4% are of unknown cause.

However, infertility is not limited to the individual and family sphere, extending its effects to society as a whole. The decline in birth rates, reflecting the growing difficulty in conceiving, contributes to a demographic phenomenon known as population ageing <sup>12</sup>.

Addressing this condition requires a comprehensive approach that goes beyond conventional medical treatments. It is crucial that society and healthcare systems understand the complexity of infertility and provide solutions addressing both physical and emotional/social aspects. An effective approach to reducing the negative effects of infertility on individuals, families, and society must be broad and multifaceted, encompassing multiple areas of intervention <sup>13</sup>.

Thus, the significant global impact of infertility requires seeking innovative solutions complementary to conventional treatments <sup>14</sup>.

Plant-based natural products have been used for thousands of years to treat diseases, long before the development of modern medicine. Historically, approximately 80% of the world's population relied on plant remedies <sup>15</sup>. This approach continues to be systematically used in various regions, including East Asia, South Asia, the Middle East, and Southeast Asia. These remedies are popular because they are accessible, culturally accepted, and considered effective <sup>16-18</sup>. Their use is associated with positive impacts on modifying cardiovascular risk factors <sup>19,20</sup>, metabolic state and related disorders <sup>21</sup>, cancer <sup>22,23</sup>, mental disorders <sup>24</sup>, gastrointestinal diseases, wound infections, dengue, and even coronavirus <sup>25</sup>.

This study aims to analyse fertility and infertility, describe conventional treatments and their limitations, and present a scientific literature review on the application of plant-based products in the field of fertility.

## 2. Infertility

Female infertility can have various origins, ranging from menstrual cycle disorders, endometriosis (uterine tissue growing outside the uterus), pelvic adhesions (scar tissue affecting organ function), ovulation difficulties, fallopian tube blockages (responsible for carrying the egg to the uterus), to elevated prolactin hormone and other structural alterations <sup>12,26</sup>.

On the other hand, multiple factors may contribute to male infertility, including biological, behavioural, and lifestyle factors, environmental exposures, and sociodemographic variables <sup>27</sup>.

Biological factors include genetics, urogenital infections, and varicoceles. Behavioural risk factors include smoking, alcohol, inappropriate body mass index, sexual behaviour, and drug use. Environmental risk factors include exposure to chemicals, pesticides, and mycotoxins. Increasing age is a sociodemographic factor associated with male infertility <sup>27</sup>. However, according to Aston *et al.* <sup>28</sup>, the cause of male infertility remains unknown in a significant proportion of patients.

Poor detection of male infertility can have serious consequences, including increased emotional burden on women and potential neglect of associated health problems ranging from cardiovascular and autoimmune disorders to cancer and death <sup>29</sup>.

### 2.1 Conventional Treatments

Conventional infertility treatment may involve medications such as clomiphene citrate (CC), human chorionic gonadotropin (hCG), follicle-stimulating hormone (FSH), human menopausal gonadotropin (hMG), gonadotropin-releasing hormone (GnRH), GnRH

analogues, bromocriptine, and cabergoline<sup>30-36</sup>. For example, gonadotropins, despite increasing the chance of pregnancy, carry risks such as multiple pregnancies (up to 36% of cycles) and ovarian hyperstimulation syndrome (1%-5% of cycles), which can have serious complications<sup>37,38</sup>. These approaches have various adverse physical and psychological reactions, such as breast tenderness, rash, nausea, vomiting, headaches, bloating, mood changes, depression, and bone density loss, among others<sup>39,40</sup>.

In women with anovulation, ovulation induction with timed intercourse is often the first treatment option, as it is less invasive<sup>37</sup>. For couples with unexplained infertility, endometriosis, or mild male infertility, ovarian stimulation (3-4 cycles) may be considered before *in vitro* fertilisation (IVF). Female age is a key determinant of fertility, and immediate IVF may be recommended for women over 38-40 years due to declining egg quality. IVF is also indicated in cases of severe male infertility or fallopian tube problems<sup>37</sup>. However, IVF has limitations regarding efficacy<sup>41,42</sup>. Additionally, this treatment is emotionally and financially burdensome for patients<sup>43</sup>.

Another treatment option is intrauterine insemination, which involves introducing sperm into the woman's uterus during ovulation. This is indicated for mild male infertility or cervical problems, though its efficacy is relatively low<sup>44,45</sup>.

In some cases, surgery may be required to correct anatomical issues, such as fallopian tube obstructions or endometriosis<sup>46,47</sup>. However, benefits may not be clinically relevant in many cases<sup>48</sup>, and scientific evidence supporting its efficacy remains limited<sup>49</sup>.

### 3. Naturopathy and Fertility

Naturopathy is a traditional medicine system recognised by the World Health Organization, based on two central philosophies: holism and vitalism<sup>50</sup>. Holism posits that "the whole" is greater than the sum of its parts, while vitalism refers to the body's natural healing capacity. Originating in Europe, naturopathy is practised in over 108 countries, representing 40% of all nations and encompassing all WHO regions<sup>51</sup>.

According to Steel *et al.*<sup>52</sup>, women trying to conceive are 1.3 times more likely to consult a naturopath. These women report that their reasons include the desire to conceive naturally, maintain health and well-being, maximise the success of assisted reproductive technology treatments, and explore alternatives when such treatments fail or are unsuitable<sup>53-55</sup>.

Naturopathic recommendations for women with gynaecological problems are generally complex and tailored to individual needs and expectations<sup>50</sup>. They may include a combination of therapies such as counselling, menstrual cycle guidance, health promotion, dietary assessment, physical activity, stress management, and ingestible substances like nutritional supplements and herbal medicines<sup>56,57</sup>.

#### 3.1 Naturopathic Techniques for Fertility

According to Maunder *et al.*<sup>50</sup> most naturopaths recommend dietary modifications, lifestyle changes, and a combination of ingestible substances for treating women with infertility. The use of multiple treatment strategies is common in naturopathy<sup>58</sup>. Several other studies report that naturopathic care includes dietary counselling and education, stress reduction techniques, physical exercise, nutritional and herbal supplementation, and other lifestyle behaviours relevant to conditions such as hypertension<sup>59</sup> and diabetes<sup>60,61</sup>. It is also common and important for naturopaths to emphasise lifestyle adjustments positively associated with preconception health promotion<sup>50</sup>. This includes avoiding environmental toxins and supporting endogenous and environmental detoxification systems<sup>62,63</sup>.

Various factors influence fertility, such as sleep quality, anxiety, depression, and lifestyle<sup>64</sup>.

Therefore, counselling and education on sleep habits and management of anxiety and depression triggers are essential to reduce risk behaviours.

For example, studies applying Yoga and Qigong suggest these techniques may benefit sleep quality <sup>65,66</sup>. Magnesium supplementation also appears to improve sleep <sup>67</sup>, as does melatonin <sup>68</sup> or tryptophan <sup>69</sup>.

Folic acid (preferably as methylfolate) has been shown to be essential for preventing neural tube defects. It is consistently associated with reduced subfertility, lower risk of pregnancy loss, and greater success in infertility treatments like IVF <sup>70</sup>. The recommended daily dose in the periconceptional period is 0.4–0.8 mg for women without a previous child with neural tube defects and 4.0 mg for women aiming to reduce recurrence risk <sup>71</sup>. However, total folate intake (from diet and supplements) should be under 1 mg/day unless medically supervised, as higher doses may mask vitamin B12 deficiency, with unknown effects at high folate levels <sup>71</sup>.

Moreover, Coenzyme Q10 is important for fertility potential, mitochondrial health, and ovarian ageing, affecting ovarian reserve and sperm health, making it relevant in IVF processes <sup>72</sup>.

Vitamin D also appears fundamental for folliculogenesis, spermatogenesis, and ovarian reserve <sup>73</sup>. Adequate levels (>30 ng/mL) are associated with higher fertilisation rates and are important for placentation, reducing the risk of gestational diabetes and preeclampsia <sup>74</sup>.

Along the same lines, supplementation with Omega-3 and antioxidants such as Vitamins C and E (in addition to the coenzyme Q10 mentioned above) may be important for improving fertility levels in both men and women <sup>75,76</sup>.

Other guidance concerns lifestyle modifications. Controlling body mass index is important to enhance a couple's fertility, making dietary review and the inclusion of physical activity in daily routines essential.

Here, orthomolecular nutrition, often integrated with functional nutrition, aims for cellular balance and body detoxification, being one of the pillars of an individualised approach to fertility.

Aromatherapy may also have beneficial effects in this context. According to Hajibagheri *et al.* <sup>77</sup>, aromatherapy with orange blossom essential oil can be used as a complementary therapy to improve mood and resilience in mothers during the third trimester of pregnancy. Inhalation of lavender essential oil has also been shown to reduce anxiety and was preferred by women during intrauterine insemination fertility treatments. Although it did not impact pregnancy rates or pain perception, its benefit in reducing anxiety and high patient acceptance suggests it may be a valuable complementary therapy in these procedures <sup>78</sup>. Furthermore, studies indicate that essential oils such as geranium or *Rosa otto* may help restore oestrogen levels in women <sup>79</sup>, while peppermint essential oil may be useful for nausea and vomiting during pregnancy <sup>80</sup>.

On the other hand, other techniques such as hydrotherapy may have indirect benefits for fertility. These may include assisting in reducing chronic stress and anxiety <sup>81-83</sup>, improving blood circulation <sup>84,85</sup>, detoxification <sup>86</sup>, relieving pain and muscle tension<sup>87-89</sup>, and improving sleep quality <sup>90</sup>.

According to the analysis conducted by Bercaw *et al.* <sup>91</sup>, one in five women (20% of respondents) believes that herbs and vitamins are safer to use during pregnancy compared to prescription medications or that they are better for treating health problems. In fact, 19% reported using medicinal plants and 47% using vitamin supplements (in addition to prenatal vitamins) during pregnancy. More than 50% of these women stated that they use them to improve overall health and energy levels, as well as to help manage pregnancy-specific problems. To better understand the potential of medicinal plants in improving fertility, some of them are explored in more detail in the following sections.

### 3.2 Medicinal Plants for Fertility

Scientific research on medicinal plants is crucial to ensure the safety, efficacy, and quality of their use. Through rigorous studies, it is possible to identify the active compounds responsible for therapeutic effects, determine the correct dosage, and investigate

possible side effects and drug interactions. Scientific research also allows for the assessment of the efficacy of different plants for various health conditions, separating traditional knowledge from unfounded claims. Additionally, studies may lead to the discovery of new therapies and drugs, contributing to advances in healthcare. By understanding the mechanisms of action of medicinal plants, it is possible to develop safer and more effective products, standardise extracts, and ensure quality control. Scientific research is essential to protect public health, prevent indiscriminate use of medicinal plants, and promote the rational and safe use of these natural resources.

Thus, this section explores the scientific evidence regarding the use of medicinal plants for fertility.

Female Fertility

The systematic review with meta-analysis by Hyun *et al.*<sup>92</sup> studied various traditional East Asian herbal therapies for female infertility. According to the results of this study, the most used herbs for female fertility are *Cuscuta Chinensis*, *Angelica gigas*, and *Cyperus rotundus*. Table 1 presents the basic characteristics of these three plants.

**Table 1.** Relevant information on *Cuscuta Chinensis*, *Angelica gigas*, and *Cyperus rotundus*.

| Name              | <i>Cuscuta Chinensis</i>                                                                                                                                                                                                     | <i>Angelica gigas</i>                                                                                                                                                                                                                 | <i>Cyperus rotundus</i>                                                                                                                                                                                                 |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Common name       | Chinese dodder                                                                                                                                                                                                               | Giant/Korean angelica                                                                                                                                                                                                                 | Nutgrass                                                                                                                                                                                                                |
| Botanical drawing |                                                                                                                                            |                                                                                                                                                    |                                                                                                                                     |
| Effects           | Improves ovarian endocrine dysfunction and increases oestrogen receptor expression in the hippocampus, hypothalamus, and pituitary glands, as well as luteinizing hormone receptor expression in the ovaries <sup>93</sup> . | Inhibits gene expression involved in inflammatory response in Polycystic Ovary Syndrome <sup>94</sup> and improves endometrial receptivity during implantation <sup>95</sup> . Helps normalise ovarian hormone levels <sup>96</sup> . | Helps treat Polycystic Ovary Syndrome by suppressing cystic follicle formation <sup>97</sup> and improving metabolic abnormalities <sup>98</sup> . Improves endometrial receptivity during implantation <sup>99</sup> . |

Among these and various other options, the authors conclude that the use of medicinal plants significantly improves pregnancy success rates, being superior to placebo controls. Thus, they find that herbal therapy can enhance clinical efficacy in patients with female infertility.

*Cuscuta chinensis* is traditionally used in Traditional Chinese Medicine (TCM) to treat various conditions, including female infertility. In TCM, it is known as *Semen Cuscutae* or *Tu Si Zi* and is valued for its tonifying properties for the kidneys and liver, systems considered essential for female reproductive health<sup>100</sup>. Approximately 3.0% of total chemical constituents are flavonoids, which have been associated with pharmacological activities

of their extracts, especially kaempferol, which exhibits antioxidant, estrogenic, and notable immune-modulating effects <sup>101</sup>.

Also widely used in traditional medicine, clinical studies suggest that *Angelica gigas* can improve ovarian function and regulate hormone levels in women with infertility. Research in rats indicated that treatment with ultrafine root powder of *Angelica gigas* normalised oestrogen levels and improved ovarian function. Additionally, a reduction in oxidative stress and inflammation markers was observed, suggesting protective effects on ovarian function <sup>96</sup>. Besides effects on ovarian function, *Angelica gigas* demonstrated potential to improve endometrial receptivity and promote embryo implantation. A study investigated the effects of decursinol, an active compound extracted from *Angelica gigas*, on embryo implantation. The results suggest that decursinol may increase the expression of genes related to endometrial receptivity and promote embryo implantation, indicating therapeutic potential for improving pregnancy rates <sup>95,102,103</sup>.

Still, regarding the mentioned plants, *Cyperus rotundus*, a perennial plant of the *Cyperaceae* family, is widely used in traditional Asian medicine to treat various gynaecological conditions. In TCM, it is known as *Xiang Fu* and is valued for its Qi-tonifying and menstrual-regulating properties. In *Ayurveda*, it is called *Musta* and is used to treat menstrual disorders, dysmenorrhea, and other conditions related to female reproductive health <sup>104</sup>.

Another study indicated that aqueous extracts from *Cyperus rotundus* tubers can improve endometrial receptivity in experimental models, suggesting therapeutic potential for improving embryo implantation rates <sup>99</sup>. Additionally, *Cyperus rotundus* demonstrated antiestrogenic effects in rat studies, indicating that tuber extracts may reduce endometrial thickness, which may be beneficial in cases of endometrial hyperplasia associated with hormonal imbalances <sup>105</sup>.

Specifically, amentoflavone, a biflavonoid isolated from plants such as *Cyperus rotundus*, has been studied for its therapeutic properties in uterine health. Studies indicate that amentoflavone possesses significant anti-uterine fibroid activity in animal models. One study demonstrated that amentoflavone reduced uterine weight, decreased serum oestrogen and progesterone levels, and improved pathological conditions of uterine tissues in rats with induced fibroids <sup>106</sup>. Furthermore, a decrease in anti-apoptotic Bcl-2 protein expression and an increase in pro-apoptotic Bax protein expression were observed, suggesting that amentoflavone may induce apoptosis in myometrial cells affected by fibroids <sup>104</sup>.

These effects indicate that amentoflavone may act as a promising therapeutic agent in managing uterine disorders, such as fibroids, which are a common cause of female infertility.

However, other plants have been studied to understand their possible effects on fertility. For example, *Trifolium pratense*, commonly known as red clover (Figure 1), is cultivated worldwide and used in various industries, such as food, pharmaceutical, and cosmetic <sup>107</sup>.

It contains several active compounds with phytoestrogenic properties, such as cinnamic acid, epigallocatechin, quercetin-3,7-diglucoside, and kaempferol-3,7-di-O-glucoside <sup>108</sup>, which mimic oestrogen in the female body, reducing menopausal symptoms by binding to ER $\beta$  receptors <sup>109,110</sup>. Furthermore, the extract of *Trifolium pratense* has been associated with balancing hormone levels, endometrial thickness, and reduction of hot flashes in postmenopausal women <sup>111</sup>. An *in vitro* study on the effect of *Trifolium pratense* extract on endometrial glandular cells isolated from premenopausal, non-pregnant women in the proliferative phase showed that the extract decreases ER- $\alpha$  expression, increases ER- $\beta$  mRNA expression, and suppresses the secretion of cytokines such as TNF- $\alpha$  and IL-1 $\alpha$ , indicating a potential regulation of ER- $\alpha/\beta$  expression by phytoestrogens at both mRNA and protein levels <sup>112</sup>. The study results indicate that *Trifolium pratense* may have therapeutic potential for various women's health conditions, such as menopausal symptoms, premenstrual syndrome, and endometriosis.



**Figure 1.** *Trifolium pratense* (public domain image).

Although many medicinal plants have preclinical studies demonstrating positive effects, only a few controlled and randomised human studies have been conducted <sup>113</sup>. Some examples include *Glycyrrhiza glabra*, *Vitex agnus-castus*, and *Matricaria chamomilla*. Table 2 presents some information about these.

**Table 2.** Relevant information on *Glycyrrhiza glabra*, *Vitex agnus-castus*, and *Matricaria chamomilla*.

| Name              | <i>Glycyrrhiza glabra</i>                                                                                                                                                                                                                                                                                   | <i>Vitex agnus-castus</i>                                                                                                                                                                                                                | <i>Matricaria chamomilla</i>                                                                                                                                                                                                         |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Common name       | Licorice                                                                                                                                                                                                                                                                                                    | Chaste tree                                                                                                                                                                                                                              | Chamomile                                                                                                                                                                                                                            |
| Botanical drawing |                                                                                                                                                                                                                          |                                                                                                                                                      |                                                                                                                                                 |
| Effects           | Prevention of vaginal atrophy, reduction of vaginal pH and dryness, pain, itching, and dyspareunia (pain during sexual intercourse) compared to the placebo group <sup>114</sup> .<br>Decreased frequency and intensity of hot flashes in postmenopausal women compared to a placebo group <sup>115</sup> . | The extract may be explored as an effective and well-tolerated treatment option to relieve symptoms of mild to moderate Premenstrual Syndrome <sup>116</sup> .<br>Significant efficacy in improving menopausal symptoms <sup>117</sup> . | Significant acceleration of the onset of labour symptoms and a decrease in pain and contractions during labour, compared to the control group <sup>118</sup> . Lower prolactin levels compared to the control group <sup>119</sup> . |

Although the studies conducted on these plants are not directly about improving fertility, they may play an important role in the female reproductive system.

In fact, *Matricaria chamomilla* extract may have positive effects on various aspects of reproductive physiology. A study focused on the growth and maturation of isolated ovarian follicles in rats showed that chamomile extract led to an increase in progesterone,  $17\beta$ -estradiol, and dehydroepiandrosterone levels. Additionally, it reduced reactive oxygen species, follicular diameter, antrum formation, and prolonged oocyte survival<sup>120</sup>. Furthermore, the phytoestrogenic compounds of *Matricaria chamomilla* demonstrated galactagogue effects by acting on dopamine receptors, leading to increased lactogenesis among breastfeeding women<sup>121</sup>.

Additionally, *Vitex agnus-castus*, traditionally used for menstrual and endocrine disorders, contains isoflavones and flavonoids that bind to oestrogen receptors, potentially improving female sexual health. Its flavonoids may improve endometrial blood flow, while its isoflavones influence the HPG axis, reducing the release of prolactin and FSH<sup>113,122</sup>.

Finally, *Glycyrrhiza glabra* is rich in phytoestrogens and may be useful for oestrogen-dependent conditions such as Polycystic Ovary Syndrome and premature ovarian failure<sup>123</sup>. It can inhibit certain enzymes involved in the production/degradation of androgens and oestrogens and increase aromatase activity<sup>124</sup>. Its flavonoids may also provide anti-cancer benefits, specifically reducing the risk of endometrial adenocarcinoma by influencing apoptotic and inflammatory pathways<sup>113</sup>.

### Male Fertility

In the study by Nguyen-Thanh *et al.*<sup>18</sup>, a meta-analysis was conducted on the effect of various medicinal plants on the male reproductive system. The results indicate that several medicinal plants have the ability to improve sperm production by enhancing semen parameters, sex hormone levels, and antioxidant profiles. Table 3 presents information on the three plants that the authors conclude show the most consistent and reliable results.

Thus, the authors conclude that medicinal plants are a valuable complementary approach in the management of male infertility, being a useful addition to conventional medical treatments.

According to the study by Shukla *et al.*<sup>136</sup>, the mechanism of action of *Mucuna pruriens* may involve the modulation of hormone levels. In this study, significant improvements were observed in testosterone (T), LH, dopamine, adrenaline, and noradrenaline levels in infertile men, while FSH and prolactin (PRL) levels were reduced. Additionally, sperm count and motility were significantly restored in infertile men after treatment.

In the case of *Withania somnifera*, this is an adaptogenic plant widely used in traditional Indian medicine (Ayurveda) to improve general health and treat various conditions, including male infertility. Clinical studies have shown that root extract may improve sperm parameters such as concentration, semen volume, and sperm motility. Specifically, a pilot study revealed a significant 167% increase in sperm count and a 53% improvement in semen volume after 90 days of treatment with 675 mg/day in men with oligospermia<sup>137</sup>.

*Withania somnifera* has also been associated with reduced cortisol levels, which can interfere with testosterone production and spermatogenesis. By reducing cortisol, it may help restore hormonal balance and improve male reproductive function<sup>138</sup>.

Furthermore, *Eurycoma longifolia*, popularly known as *Tongkat Ali*, is a plant traditionally used in Southeast Asia to enhance male sexual health and treat infertility. Clinical studies have shown that *Eurycoma longifolia* extract can improve sperm parameters such as concentration, motility, and morphology.

**Table 3.** Relevant information on *Mucuna pruriens*, *Withania somnifera*, and *Eurycoma longifolia*.

| Name              | <i>Mucuna pruriens</i>                                                                                                                                                                                                                                                                                                                                                                                         | <i>Withania somnifera</i>                                                                                                                                                                                                       | <i>Eurycoma longifolia</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Common name       | Florida bean                                                                                                                                                                                                                                                                                                                                                                                                   | Ashwagandha, Indian ginseng                                                                                                                                                                                                     | Tongkat Ali                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Botanical drawing |                                                                                                                                                                                                                                                                                                                               |                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Effects           | Improves sperm parameters, hormonal levels, and antioxidant profile in men, in addition to assisting female ovulation, reducing stress <sup>125-127</sup> and presenting antioxidant, hypoglycemic, lipid-lowering, and neuroprotective properties <sup>128</sup> . Rich in l-DOPA <sup>129</sup> , it increases sex hormones, reduces reactive oxygen species, and may improve libido and sexual performance. | Its antioxidant properties, due to flavonoids and phenolics, may protect sperm from harmful reactive oxygen species <sup>18,130</sup> . It may improve pregnancy outcomes by managing stress-induced infertility <sup>131</sup> | May improve male fertility by increasing testosterone, sperm quality, and overall reproductive health <sup>132</sup> . Its antioxidant properties may enhance semen quality by reducing oxidative stress <sup>133</sup> . In addition, its anti-estrogenic effects may counteract the negative impacts of high estrogen levels on testosterone production <sup>134</sup> . A glycopeptide found in the plant may contribute to its aphrodisiac and fertility-enhancing properties <sup>132,135</sup> . |

A study involving 350 infertile men showed that treatment with 200 mg/day of *Eurycoma longifolia* extract resulted in significant improvements in semen quality, including increased sperm concentration and the percentage of sperm with normal morphology. In addition, 11 couples (14.7%) conceived spontaneously after treatment <sup>139</sup>. Beyond effects on sperm parameters, *Eurycoma longifolia* has shown potential to increase testosterone levels. A systematic review and meta-analysis of randomised clinical trials revealed a significant increase in total testosterone levels in men treated with *Eurycoma longifolia*, especially in those with hypogonadism <sup>140</sup>.

The study by Roozbeh *et al.* <sup>141</sup> also supports the results regarding the use of *Withania somnifera* and *Mucuna pruriens* for male fertility. On the other hand, it also reviews various studies on other plants, especially Ginseng and *Nigella sativa* (Table 4).

Indeed, a randomised, double-blind, placebo-controlled study investigated the effects of *Panax ginseng* on semen quality in infertile men. The results indicated significant improvements in sperm concentration, motility, morphology, and viability after treatment with ginseng. However, no significant differences were observed in serum levels of follicle-stimulating hormone (FSH), luteinizing hormone (LH), or testosterone between the treated groups and the control group. The incidence of adverse effects was low and considered irrelevant for the treatments administered <sup>142</sup>.

**Table 4.** Relevant information on *Panax ginseng* and *Nigella sativa*.

| Name              | <i>Panax ginseng</i>                                                                                                                                                                                                                                                                                     | <i>Nigella Sativa</i>                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Common name       | Korean ginseng                                                                                                                                                                                                                                                                                           | Black cumin, black seed                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Botanical drawing |                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                  |
| Effects           | It may enhance spermatogenesis by increasing the expression of glial cell line-derived neurotrophic factor, as evidenced by clinical trials and animal studies. Ginseng also positively regulates steroid hormone metabolism, potentially exerting anti-ageing effects on the testicles <sup>142</sup> . | It demonstrates positive effects on sperm and reproductive parameters. These benefits are likely linked to the plant's antioxidant properties, which help improve spermatogenesis <sup>141</sup> . Although the exact mechanisms are not fully understood, it is believed that the antioxidants in <i>Nigella sativa</i> play a key role by neutralising reactive oxygen species, thereby preventing oxidative stress that can damage spermatozoa <sup>143</sup> . |

In turn, *Nigella sativa* has been studied for its effects on improving sperm parameters in infertile men. A randomised, placebo-controlled clinical trial demonstrated that daily intake of 5 ml of *Nigella sativa* oil for two months resulted in significant improvements in sperm count, motility, morphology, semen volume, pH, and round cells <sup>144</sup>.

In addition to its potent antioxidant effect <sup>143</sup>, the mechanism of action of *Nigella sativa* may involve the modulation of hormonal levels. A study observed significant increases in serum FSH, LH, and testosterone after three months of treatment with *Nigella sativa*, suggesting a positive effect on hormonal function that may contribute to improvements in semen quality <sup>145</sup>.

Another study by Boroujeni *et al.* <sup>146</sup> presented several other medicinal plants with positive effects on male fertility, including *Apium graveolens*, *Cinnamomum camphora*, *Cornus mas*, *Satureja khuzestanica*, *Fumaria parviflora*, *Zingiber officinale*, *Cinnamomum zeylanicum*, and *Phoenix dactylifera*.

In line with the studies presented above, these authors conclude that the positive effects on male fertility are likely attributable to the antioxidant power of these plants.

Indeed, several studies have shown that reactive oxygen species (ROS), although important for cellular communication at normal levels, can cause male infertility when produced in excess or when the body is unable to neutralise them. When there is an imbalance between ROS production and the body's antioxidant capacity, oxidative stress occurs. This stress can negatively affect spermatogenesis, sperm function, structure, motility, and viability, the acrosome reaction (an essential process for fertilisation), the interaction between sperm and oocyte, and even fertilisation and embryo implantation <sup>147-149</sup>.

#### 4. Final Considerations

Infertility is a complex health problem with global impact. Conventional treatments have limitations, and the search for safe and effective alternatives is essential.

Naturopathy seeks to view the human being holistically, considering symptoms as part of the interaction between body, mind, and environment. In this sense, through its various approaches, it aims to promote balance and self-regulation of the organism, respecting nature and encouraging practices that foster vitality and prevention, whether through diet, meditation, massage, or mind-body techniques, among others.

Within this context, medicinal plants represent a promising field of research, with studies demonstrating the potential of various species to improve both female and male fertility. However, it is crucial that the use of medicinal plants be carried out under the guidance of qualified health professionals, and that scientific research continues to advance in order to validate their efficacy and safety.

This study provides a comprehensive overview of fertility and infertility, conventional treatments, and the promising potential of plant-based natural products as complementary therapies. Scientific research is essential to ensure that the use of medicinal plants is conducted safely and effectively, opening the door to new approaches in the treatment of infertility.

#### 5. Conclusions

This study highlights the potential of medicinal plants as a complement to conventional infertility treatments. Ongoing scientific research is fundamental to validate their efficacy and safety, offering new hope for couples seeking to achieve the goal of having children.

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#### References

1. Nath S, Nahar L, Sarker SD. Chapter Fifteen - Fertility regulating natural products. In: Sarker SD, Nahar L, editors. Annual Reports in Medicinal Chemistry. 55: Academic Press; 2020. p. 459-79. 0065-7743.
2. Weiss RV, Clapauch R. Female infertility of endocrine origin. Arq Bras Endocrinol Metabol. 2014;58(2):144-52. doi: <https://doi.org/10.1590/0004-2730000003021>

3. Mascarenhas MN, Flaxman SR, Boerma T, Vanderpoel S, Stevens GA. National, regional, and global trends in infertility prevalence since 1990: a systematic analysis of 277 health surveys. *PLoS Med.* 2012;9(12):e1001356. doi: <https://doi.org/10.1371/journal.pmed.1001356>
4. Usadi RS, Merriam KS. On-label and off-label drug use in the treatment of female infertility. *Fertil Steril.* 2015;103(3):583-94. doi: <https://doi.org/10.1016/j.fertnstert.2015.01.011>
5. Njagi P, Groot W, Arsenijevic J, Dyer S, Mburu G, Kiarie J. Financial costs of assisted reproductive technology for patients in low- and middle-income countries: a systematic review. *Human Reproduction Open.* 2023;2023(2):hoad007. doi: <https://doi.org/10.1093/hropen/hoad007>
6. Inhorn MC, Patrizio P. Infertility around the globe: new thinking on gender, reproductive technologies and global movements in the 21st century. *Hum Reprod Update.* 2015;21(4):411-26. doi: <https://doi.org/10.1093/humupd/dmv016>
7. Schmidt L. Psychosocial burden of infertility and assisted reproduction. *The Lancet.* 2006;367(9508):379-80. doi: [https://doi.org/10.1016/S0140-6736\(06\)68117-8](https://doi.org/10.1016/S0140-6736(06)68117-8)
8. Whiteford LM, Gonzalez L. Stigma: The hidden burden of infertility. *Soc Sci Med.* 1995;40(1):27-36. doi: [https://doi.org/10.1016/0277-9536\(94\)00124-C](https://doi.org/10.1016/0277-9536(94)00124-C)
9. Dyer SJ, Patel M. The economic impact of infertility on women in developing countries-a systematic review. *Facts, views & vision in ObGyn.* 2012;4(2):102.
10. Vander Borgh M, Wyns C. Fertility and infertility: Definition and epidemiology. *Clinical biochemistry.* 2018;62:2-10.
11. Tamrakar SR, Bastakoti R. Determinants of infertility in couples. 2019
12. World Health Organization. Recent advances in medically assisted conception: report of a WHO scientific group [meeting held in Geneva from 2 to 6 April 1990]: World Health Organization; 1992. 9241208201.
13. World Health Organization. Infertility 2024 [Available from: <https://www.who.int/news-room/fact-sheets/detail/infertility>.
14. Aguiar R, Gehlen S, Oliveira R, Rodrigues JM. Recent advances in Chinese phytopharmacology for female infertility: A systematic review of high-quality randomized controlled trials. *Pharmacological Research - Modern Chinese Medicine.* 2024;13:100539. doi: <https://doi.org/10.1016/j.prmcm.2024.100539>
15. Woo CSJ, Lau JSH, El-Nezami H. Herbal medicine: toxicity and recent trends in assessing their potential toxic effects. *Advances in botanical research.* 62: Elsevier; 2012. p. 365-84. 0065-2296.
16. Ahmad MK, Mahdi AA, Shukla KK, Islam N, Rajender S, Madhukar D, et al. Withania somnifera improves semen quality by regulating reproductive hormone levels and oxidative stress in seminal plasma of infertile males. *Fertil Steril.* 2010;94(3):989-96. doi: <https://doi.org/10.1016/j.fertnstert.2009.04.046>
17. Nazari SM, Naseri M, Mokri A, Davati A, Kamalinejad M. Hab-o Shefa (an Iranian traditional medicine compound) in withdrawal syndrome and its effects in acute detoxification of opiates addict: A randomized, double blind, clinical trials. *J Med Plant Res.* 2013;7(22):1628-35.
18. Nguyen-Thanh T, Dang-Ngoc P, Bui M-H, Le-Minh T, Nguyen-Vu Q-H. Effectiveness of Herbal medicines on male reproductive system: Evidence from meta-analysis. *Pharmacological Research - Modern Chinese Medicine.* 2024;12:100462. doi: <https://doi.org/10.1016/j.prmcm.2024.100462>
19. Kheirmandparizi M, Keshavarz P, Nowrouzi-Sohrabi P, Hosseini-Bensenjan M, Rezaei S, Kashani SMA, et al. Effects of garlic extract on lipid profile in patients with coronary artery disease: A systematic review and meta-analysis of randomised clinical trials. *Int J Clin Pract.* 2021;75(12):e14974. doi: <https://doi.org/10.1111/ijcp.14974>
20. Pourmasoumi M, Hadi A, Marx W, Najafgholizadeh A, Kaur S, Sahebkar A. The Effect of Green Coffee Bean Extract on Cardiovascular Risk Factors: A Systematic Review and Meta-analysis. *Adv Exp Med Biol.* 2021;1328:323-45. doi: [https://doi.org/10.1007/978-3-030-73234-9\\_21](https://doi.org/10.1007/978-3-030-73234-9_21)

21. Izadi B, Joulaei H, Lankarani KB, Tabrizi R, Taherifard E, Sadeghpour A, et al. The effect of green cardamom on blood pressure and inflammatory markers among patients with metabolic syndrome and related disorders: A systematic review and meta-analysis of randomized clinical trials. *Phytotherapy Research*. 2023;37(2):679-88.
22. Ho VW, Tan HY, Guo W, Li S, Wang N, Meng W, et al. Efficacy and Safety of Chinese Herbal Medicine on Treatment of Breast Cancer: A Meta-analysis of Randomized Controlled Trials. *Am J Chin Med*. 2021;49(7):1557-75. doi: <https://doi.org/10.1142/S0192415X21500737>
23. Zhang XW, Liu W, Jiang HL, Mao B. Chinese Herbal Medicine for Advanced Non-Small-Cell Lung Cancer: A Systematic Review and Meta-Analysis. *Am J Chin Med*. 2018;46(5):923-52. doi: <https://doi.org/10.1142/S0192415X18500490>
24. Yeung KS, Hernandez M, Mao JJ, Haviland I, Gubili J. Herbal medicine for depression and anxiety: A systematic review with assessment of potential psycho-oncologic relevance. *Phytotherapy research : PTR*. 2018;32(5):865-91. doi: <https://doi.org/10.1002/ptr.6033>
25. Chaughule RS, Barve RS. Role of herbal medicines in the treatment of infectious diseases. *Vegetos*. 2024;37(1):41-51.
26. Abrao MS, Muzii L, Marana R. Anatomical causes of female infertility and their management. *International Journal of Gynecology & Obstetrics*. 2013;123:S18-S24.
27. Okonofua FE, Ntoimo LFC, Omonkhua A, Ayodeji O, Olafusi C, Unuabonah E, et al. Causes and Risk Factors for Male Infertility: A Scoping Review of Published Studies. *Int J Gen Med*. 2022;15:5985-97. doi: <https://doi.org/10.2147/IJGM.S363959>
28. Aston KI, Conrad DF. A review of genome-wide approaches to study the genetic basis for spermatogenic defects. *Methods Mol Biol*. 2013;927:397-410. doi: [https://doi.org/10.1007/978-1-62703-038-0\\_34](https://doi.org/10.1007/978-1-62703-038-0_34)
29. Choy JT, Eisenberg ML. Male infertility as a window to health. *Fertil Steril*. 2018;110(5):810-4. doi: <https://doi.org/10.1016/j.fertnstert.2018.08.015>
30. Dorn C, Ou Q, Svaren J, Crawford PA, Sadovsky Y. Activation of luteinizing hormone  $\beta$  gene by gonadotropin-releasing hormone requires the synergy of early growth response-1 and steroidogenic factor-1. *Journal of Biological Chemistry*. 1999;274(20):13870-6.
31. Gleicher N, Weghofer A, Barad DH. Discordances between follicle stimulating hormone (FSH) and anti-Müllerian hormone (AMH) in female infertility. *Reproductive Biology and Endocrinology*. 2010;8(1):1-7.
32. Liu Y, Yi X, Zhuang Y, Zhang S. Limitations in the process of transcription and translation inhibit recombinant human chorionic gonadotropin expression in CHO cells. *Journal of Biotechnology*. 2015;204:63-9.
33. Pang SC. Use of follicle-stimulating hormone for the treatment of female infertility—current concepts. *Women's Health*. 2005;1(1):87-95.
34. Propst AM, Bates GW. Evaluation and treatment of anovulatory and unexplained infertility. *Obstetrics and Gynecology Clinics*. 2012;39(4):507-19.
35. Ratner LD, Gonzalez B, Ahtiainen P, Di Giorgio NP, Poutanen M, Calandra RS, et al. Short-term pharmacological suppression of the hyperprolactinemia of infertile hCG-overproducing female mice persistently restores their fertility. *Endocrinology*. 2012;153(12):5980-92.
36. Thorner M, Besser G, Jones A, Dacie J, Jones A. Bromocriptine treatment of female infertility: report of 13 pregnancies. *Br Med J*. 1975;4(5998):694-7.
37. Carson SA, Kallen AN. Diagnosis and Management of Infertility: A Review. *JAMA*. 2021;326(1):65-76. doi: <https://doi.org/10.1001/jama.2021.4788>
38. Kumar P, Sharma A. Gonadotropin-releasing hormone analogs: Understanding advantages and limitations. *Journal of Human Reproductive Sciences*. 2014;7(3).
39. Ma K. Present situation and question and prospect of study on kidney-supplementing and blood-activating method in treating ovaries functional disorders (infertility with dysfunctional ovulation) for stimulating ovaries reactive mechanism to gonadotropic hormones. *China Journal of Chinese Materia Medica*. 2011;36(17):2441-4.

40. Usadi RS, Merriam KS. On-label and off-label drug use in the treatment of female infertility. *Fertil Steril*. 2015;103(3):583-94.
41. Ola B, Li T-C. Implantation failure following in-vitro fertilization. *Current Opinion in Obstetrics and Gynecology*. 2006;18(4).
42. Macklon NS. The true incidence of recurrent implantation failure. *Current Opinion in Obstetrics and Gynecology*. 2022;34(3).
43. Xia J-f, Inagaki Y, Zhang J-f, Wang L, Song P-p. Chinese medicine as complementary therapy for female infertility. *Chinese journal of integrative medicine*. 2017;23(4):245-52.
44. The Eshre Capri Workshop Group. Intrauterine insemination. *Human Reproduction Update*. 2009;15(3):265-77. doi: <https://doi.org/10.1093/humupd/dmp003>
45. Duran HE, Morshedi M, Kruger T, Oehninger S. Intrauterine insemination: a systematic review on determinants of success. *Human Reproduction Update*. 2002;8(4):373-84. doi: <https://doi.org/10.1093/humupd/8.4.373>
46. Coccia ME, Rizzello F, Cammilleri F, Bracco GL, Scarselli G. Endometriosis and infertility: surgery and ART: an integrated approach for successful management. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 2008;138(1):54-9.
47. Chua SJ, Akande VA, Mol BWJ. Surgery for tubal infertility. *Cochrane Database of Systematic Reviews*. 2017(1). doi: <https://doi.org/10.1002/14651858.CD006415.pub3>
48. Vercellini P, Somigliana E, Viganò P, Abbiati A, Barbara G, Crosignani PG. Surgery for endometriosis-associated infertility: a pragmatic approach. *Human Reproduction*. 2009;24(2):254-69. doi: <https://doi.org/10.1093/humrep/den379>
49. Pandian Z, Akande VA, Harrild K, Bhattacharya S. Surgery for tubal infertility. *Cochrane Database of Systematic Reviews*. 2008(3). doi: <https://doi.org/10.1002/14651858.CD006415.pub2>
50. Maunder A, Arentz S, Armour M, Costello MF, Ee C. Naturopaths' approach to care of women with infertility: A cross-sectional survey. *European Journal of Integrative Medicine*. 2024;66:102329. doi: <https://doi.org/10.1016/j.eujim.2023.102329>
51. Lloyd I, Steel A, Wardle J. Naturopathy: practice, effectiveness, economics & safety: World Naturopathic Federation; 2021. 1777691915.
52. Steel A, Adams J, Sibbritt D. The Characteristics of Women Who Use Complementary Medicine While Attempting to Conceive: Results from a Nationally Representative Sample of 13,224 Australian Women. *Women's Health Issues*. 2017;27(1):67-74. doi: <https://doi.org/10.1016/j.whi.2016.09.010>
53. Rayner J-A, McLachlan HL, Forster DA, Cramer R. Australian women's use of complementary and alternative medicines to enhance fertility: exploring the experiences of women and practitioners. *BMC complementary and alternative medicine*. 2009;9(1):52. doi: <https://doi.org/10.1186/1472-6882-9-52>
54. Charaf S, Wardle JL, Sibbritt DW, Lal S, Callaway LK. Women's use of herbal and alternative medicines for preconception care. *Australian and New Zealand Journal of Obstetrics and Gynaecology*. 2015;55(3):222-6. doi: <https://doi.org/10.1111/ajo.12324>
55. Rayner J-A, Willis K, Burgess R. Women's Use of Complementary and Alternative Medicine for Fertility Enhancement: A Review of the Literature. *The Journal of Alternative and Complementary Medicine*. 2011;17(8):685-90. doi: <https://doi.org/10.1089/acm.2010.0435>
56. O'Reilly E, Sevigny M, Sabarre K-A, Phillips KP. Perspectives of complementary and alternative medicine (CAM) practitioners in the support and treatment of infertility. *BMC complementary and alternative medicine*. 2014;14(1):394. doi: <https://doi.org/10.1186/1472-6882-14-394>
57. Brosnan C, Tickner C, Davies K, Heinsch M, Steel A, Vuolanto P. The salutogenic gaze: Theorising the practitioner role in complementary and alternative medicine consultations. *Sociology of Health & Illness*. 2023;45(5):1008-27. doi: <https://doi.org/10.1111/1467-9566.13629>
58. Steel A, Goldenberg JZ, Hawrelak JA, Foley H, Gerontakos S, Harnett JE, et al. Integrative physiology and traditional naturopathic practice: results of an international observational study. *Integrative Medicine Research*. 2020;9(4):100424. doi: <https://doi.org/10.1016/j.imr.2020.100424>
59. Bradley R, Kozura E, Kaltunas J, Oberg EB, Probstfield J, Fitzpatrick AL. Observed changes in risk during naturopathic treatment of hypertension. *Evidence-Based Complementary and Alternative Medicine*. 2011;2011(1):826751.

60. Bradley R, Oberg EB. Naturopathic medicine and type 2 diabetes: a retrospective analysis from an academic clinic. *Alternative medicine review: a journal of clinical therapeutic*. 2006;11(1):30.
61. Bradley R, Sherman KJ, Catz S, Calabrese C, Oberg EB, Jordan L, et al. Adjunctive naturopathic care for type 2 diabetes: patient-reported and clinical outcomes after one year. *BMC complementary and alternative medicine*. 2012;12(1):44.
62. Knapen MF, Zusterzeel PL, Peters WH, Steegers EA. Glutathione and glutathione-related enzymes in reproduction: a review. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 1999;82(2):171-84.
63. Segal TR, Giudice LC. Before the beginning: environmental exposures and reproductive and obstetrical outcomes. *Fertility and sterility*. 2019;112(4):613-21.
64. Shkurenko YV, Ibatov AD, Sahakyan KS, Mirzalieva SZ, Shukurlu AR. [The effect of sleep and other medical and social factors on a woman's reproductive function]. *Zh Nevrol Psikiatr Im S S Korsakova*. 2025;125(5. Vyp. 2):81-6. doi: <https://doi.org/10.17116/jnevro202512505281>
65. Wang WL, Chen KH, Pan YC, Yang SN, Chan YY. The effect of yoga on sleep quality and insomnia in women with sleep problems: a systematic review and meta-analysis. *BMC Psychiatry*. 2020;20(1):195. doi: <https://doi.org/10.1186/s12888-020-02566-4>
66. Carcelén-Fraile MDC, Aibar-Almazán A, Martínez-Amat A, Jiménez-García JD, Brandão-Loureiro V, García-Garro PA, et al. Qigong for mental health and sleep quality in postmenopausal women: A randomized controlled trial. *Medicine (Baltimore)*. 2022;101(39):e30897. doi: <https://doi.org/10.1097/md.00000000000030897>
67. Arab A, Rafie N, Amani R, Shirani F. The Role of Magnesium in Sleep Health: a Systematic Review of Available Literature. *Biol Trace Elem Res*. 2023;201(1):121-8. doi: <https://doi.org/10.1007/s12011-022-03162-1>
68. Fatemeh G, Sajjad M, Niloufar R, Neda S, Leila S, Khadijeh M. Effect of melatonin supplementation on sleep quality: a systematic review and meta-analysis of randomized controlled trials. *J Neurol*. 2022;269(1):205-16. doi: <https://doi.org/10.1007/s00415-020-10381-w>
69. Sutanto CN, Loh WW, Kim JE. The impact of tryptophan supplementation on sleep quality: a systematic review, meta-analysis, and meta-regression. *Nutr Rev*. 2022;80(2):306-16. doi: <https://doi.org/10.1093/nutrit/nuab027>
70. Mezzomo CLS, Garcias GdL, Sclowitz ML, Sclowitz IT, Brum CB, Fontana T, et al. Prevenção de defeitos do tubo neural: prevalência do uso da suplementação de ácido fólico e fatores associados em gestantes na cidade de Pelotas, Rio Grande do Sul, Brasil. *Cadernos de Saúde Pública*. 2007;23.
71. Centers for Disease Control and Prevention. Recommendations for the use of folic acid to reduce the number of cases of spina bifida and other neural tube defects. *MMWR Recomm Rep*. 1992;41(RR-14):1-7.
72. Florou P, Anagnostis P, Theocharis P, Chourdakis M, Goulis DG. Does coenzyme Q(10) supplementation improve fertility outcomes in women undergoing assisted reproductive technology procedures? A systematic review and meta-analysis of randomized-controlled trials. *J Assist Reprod Genet*. 2020;37(10):2377-87. doi: <https://doi.org/10.1007/s10815-020-01906-3>
73. Chen Y, Zhi X. Roles of Vitamin D in Reproductive Systems and Assisted Reproductive Technology. *Endocrinology*. 2020;161(4). doi: <https://doi.org/10.1210/endocr/bqaa023>
74. Ferrari D, Lombardi G, Banfi G. Concerning the vitamin D reference range: pre-analytical and analytical variability of vitamin D measurement. *Biochimica medica*. 2017;27(3):453-66.
75. Kaltsas A. Oxidative Stress and Male Infertility: The Protective Role of Antioxidants. *Medicina [Internet]*. 2023; 59(10). doi: <https://doi.org/10.3390/medicina59101769>
76. Trop-Steinberg S, Gal M, Azar Y, Kilav-Levin R, Heifetz EM. Effect of omega-3 supplements or diets on fertility in women: A meta-analysis. *Heliyon*. 2024;10(8):e29324. doi: <https://doi.org/10.1016/j.heliyon.2024.e29324>
77. Hajibagheri F, Fahami F, Valiani M. The effects of aromatherapy on the mood state and resilience of pregnant women: A clinical trial. *J Educ Health Promot*. 2024;13:97. doi: [https://doi.org/10.4103/jehp.jehp\\_1794\\_22](https://doi.org/10.4103/jehp.jehp_1794_22)

78. Jones T, Purdy M, Stewart EA, Cutshall SM, Hathcock MA, Mahapatra S, et al. Lavender Aromatherapy to Reduce Anxiety During Intrauterine Insemination: A Randomized Controlled Trial. *Glob Adv Health Med*. 2021;10:21649561211059074. doi: <https://doi.org/10.1177/21649561211059074>
79. Shinohara K, Doi H, Kumagai C, Sawano E, Tarumi W. Effects of essential oil exposure on salivary estrogen concentration in perimenopausal women. *Neuro Endocrinol Lett*. 2017;37(8):567-72.
80. Safajou F, Soltani N, Taghizadeh M, Amouzesi Z, Sandrous M. The Effect of Combined Inhalation Aromatherapy with Lemon and Peppermint on Nausea and Vomiting of Pregnancy: A Double-Blind, Randomized Clinical Trial. *Iran J Nurs Midwifery Res*. 2020;25(5):401-6. doi: [https://doi.org/10.4103/ijnmr.IJNMR\\_11\\_19](https://doi.org/10.4103/ijnmr.IJNMR_11_19)
81. Chowdhury RS, Islam MD, Akter K, Sarkar MAS, Roy T, Rahman ST. Therapeutic aspects of hydrotherapy: a review. *Bangladesh Journal of Medicine*. 2021;32(2):138-41.
82. Benfield RD, Hortobágyi T, Tanner CJ, Swanson M, Heitkemper MM, Newton ER. The effects of hydrotherapy on anxiety, pain, neuroendocrine responses, and contraction dynamics during labor. *Biological research for nursing*. 2010;12(1):28-36.
83. Koroglu S, Yıldız M. Effectiveness of hydrotherapy and balneotherapy for anxiety and depression symptoms: a meta-analysis. *Current Psychology*. 2024;43(29):24193-204.
84. Mooventhana A, Nivethitha L. Scientific evidence-based effects of hydrotherapy on various systems of the body. *North American journal of medical sciences*. 2014;6(5):199.
85. Franchimont P, Juchmes J, Lecomte J. Hydrotherapy-mechanisms and indications. *Pharmacology & therapeutics*. 1983;20(1):79-93.
86. Wardle J. Hydrotherapy: a forgotten Australian therapeutic modality. *Australian Journal of Herbal Medicine*. 2013;25(1):12-7.
87. Dias JM, Cisneros L, Dias R, Fritsch C, Gomes W, Pereira L, et al. Hydrotherapy improves pain and function in older women with knee osteoarthritis: a randomized controlled trial. *Brazilian journal of physical therapy*. 2017;21(6):449-56.
88. McIlveen B, Robertson VJ. A randomised controlled study of the outcome of hydrotherapy for subjects with low back or back and leg pain. *Physiotherapy*. 1998;84(1):17-26.
89. Bender T, Karagülle Z, Bálint GP, Gutenbrunner C, Bálint PV, Sukenik S. Hydrotherapy, balneotherapy, and spa treatment in pain management. *Rheumatology international*. 2005;25(3):220-4.
90. Moini Jazani A, Nasimi Doost Azgomi H, Nasimi Doost Azgomi A, Hossein Ayati M, Nasimi Doost Azgomi R. Efficacy of hydrotherapy, spa therapy, and balneotherapy on sleep quality: a systematic review. *International Journal of Biometeorology*. 2023;67(6):975-91. doi: <https://doi.org/10.1007/s00484-023-02471-x>
91. Bercaw J, Maheshwari B, Sangi-Haghpeykar H. The use during pregnancy of prescription, over-the-counter, and alternative medications among Hispanic women. *Birth*. 2010;37(3):211-8. doi: <https://doi.org/10.1111/j.1523-536X.2010.00408.x>
92. Hyun J-Y, Jung H-S, Park J-Y. Herbal therapeutics for female infertility: A systematic review and meta-analysis. *Journal of ethnopharmacology*. 2024;319:117258. doi: <https://doi.org/10.1016/j.jep.2023.117258>
93. Hung Y-C, Kao C-W, Lin C-C, Liao Y-N, Wu B-Y, Hung I-L, et al. Chinese herbal products for female infertility in Taiwan: a population-based cohort study. *Medicine*. 2016;95(11):e3075.
94. Ryu K-J, Cho S-H. Effects of Angelicae gigantis radix on gene expression of ovarian tissue in polycystic ovary syndrome rats. *The Journal of Korean Obstetrics and Gynecology*. 2011;24(3):28-47.
95. Kim SE, Lee JE, Han YH, Lee SI, Kim DK, Park SR, et al. Decursinol from Angelica gigas Nakai enhances endometrial receptivity during implantation. *BMC complementary medicine and therapies*. 2020;20(1):36. doi: <https://doi.org/10.1186/s12906-020-2822-z>
96. Choi K-O, Lee I, Paik S-Y-R, Kim DE, Lim JD, Kang W-S, et al. Ultrafine Angelica gigas Powder Normalizes Ovarian Hormone Levels and Has Antiosteoporosis Properties in Ovariectomized Rats: Particle Size Effect. *Journal of Medicinal Food*. 2012;15(10):863-72. doi: <https://doi.org/10.1089/jmf.2011.2047>

97. Yang D-S, Yang D-S, Cho S-H, Park K-M, Kim H-W, Cho S-I. Effects of Cyperi Rhizoma (CR) on the polycystic ovaries induced by estradiol valerate in rats. *The Journal of Korean Obstetrics and Gynecology*. 2010;23(4):35-46.
98. Park C-I, Park K-M. Effects of cyperi rhizoma on relevant conditions of metabolic syndrome in rats with polycystic ovary syndrome. *The Journal of Korean Obstetrics and Gynecology*. 2011;24(4):20-30.
99. Choi HJ, Chung TW, Park MJ, Jung YS, Lee SO, Kim KJ, et al. Water-extracted tubers of *Cyperus rotundus* L. enhance endometrial receptivity through leukemia inhibitory factor-mediated expression of integrin  $\alpha V\beta 3$  and  $\alpha V\beta 5$ . *Journal of ethnopharmacology*. 2017;208:16-23. doi: <https://doi.org/10.1016/j.jep.2017.06.051>
100. Feng H, Zhou H, Shang Y. The effectiveness and safety of Chinese herbal medicine in infertile women with luteal phase deficiency: a systematic review and meta-analysis. *Ann Palliat Med*. 2022;11(7):2492-502. doi: <https://doi.org/10.21037/apm-22-792>
101. Donnapree S, Li J, Yang X, Ge AH, Donkor PO, Gao XM, et al. *Cuscuta chinensis* Lam.: A systematic review on ethnopharmacology, phytochemistry and pharmacology of an important traditional herbal medicine. *Journal of ethnopharmacology*. 2014;157:292-308. doi: <https://doi.org/10.1016/j.jep.2014.09.032>
102. Bae WJ, Ha US, Choi JB, Kim KS, Kim SJ, Cho HJ, et al. Protective Effect of Decursin Extracted from *Angelica gigas* in Male Infertility via Nrf2/HO-1 Signaling Pathway. *Oxid Med Cell Longev*. 2016;2016:5901098. doi: <https://doi.org/10.1155/2016/5901098>
103. Lu J, Jiang C, Drabick JJ, Joshi M, Perimbeti S. *Angelica gigas* Nakai (Korean Dang-gui) Root Alcoholic Extracts in Health Promotion and Disease Therapy - active Phytochemicals and In Vivo Molecular Targets. *Pharm Res*. 2025;42(1):25-47. doi: <https://doi.org/10.1007/s11095-024-03809-9>
104. Ying J, Bing X. Chemical constituents of *Cyperus rotundus* L. and their inhibitory effects on uterine fibroids. *Afr Health Sci*. 2016;16(4):1000-6. doi: <https://doi.org/10.4314/ahs.v16i4.16>
105. Busman H, Yanwirasti, Jamsari A, Hon Tjong D, Kanedi M. Antiestrogenic effect of tuber extract of *Cyperus rotundus* L. on the endometrial thickness of mice (*Mus musculus* L.). *World Journal of Pharmaceutical and Life Sciences*. 2016;2:341-7.
106. Lin Y, Yang C, Tang J, Li C, Zhang ZM, Xia BH, et al. Characterization and anti-uterine tumor effect of extract from *Prunella vulgaris* L. *BMC complementary medicine and therapies*. 2020;20(1):189. doi: <https://doi.org/10.1186/s12906-020-02986-5>
107. McKenna P, Cannon N, Conway J, Dooley J, Davies WP. Red clover (*Trifolium pratense*) in conservation agriculture: a compelling case for increased adoption. *International Journal of Agricultural Sustainability*. 2018;16(4-5):342-66.
108. Akbaribazm M, Goodarzi N, Rahimi M. Female infertility and herbal medicine: An overview of the new findings. *Food science & nutrition*. 2021;9(10):5869-82.
109. Hidalgo LA, Chedraui PA, Morocho N, Ross S, San Miguel G. The effect of red clover isoflavones on menopausal symptoms, lipids and vaginal cytology in menopausal women: a randomized, double-blind, placebo-controlled study. *Gynecological Endocrinology*. 2005;21(5):257-64.
110. Salimpour F, Mostafavi G, Sharifnia F. Micromorphologic study of the seed of the genus *Trifolium*, section *Lotoidea*, in Iran. *Pakistan Journal of Biological Sciences*. 2007;10(3):378-82.
111. van de Weijer PH, Barentsen R. Isoflavones from red clover (Promensil®) significantly reduce menopausal hot flush symptoms compared with placebo. *Maturitas*. 2002;42(3):187-93.
112. Staar S, Richter D-U, Makovitzky J, Briese V, Bergemann C. Stimulation of endometrial glandular cells with genistein and daidzein and their effects on ER $\alpha$ - and ER $\beta$ -mRNA and protein expression. *Anticancer research*. 2005;25(3A):1713-8.
113. Masjedi M, Izadi Y, Montahaei T, Mohammadi R, Ali Helforoush M, Rohani Rad K. An illustrated review on herbal medicine used for the treatment of female infertility. *European Journal of Obstetrics & Gynecology and Reproductive Biology*. 2024;302:273-82. doi: <https://doi.org/10.1016/j.ejogrb.2024.09.028>
114. Sadeghi M, Namjouyan F, Cheraghian B, Abbaspoor Z. Impact of *Glycyrrhiza glabra* (licorice) vaginal cream on vaginal signs and symptoms of vaginal atrophy in postmenopausal women: A randomized double blind controlled trial. *Journal of Traditional and Complementary Medicine*. 2020;10(2):110-5.

115. Nahidi F, Zare E, Mojab F, Alavi-Majd H. Effects of licorice on relief and recurrence of menopausal hot flashes. *Iran J Pharm Res.* 2012;11(2):541-8.
116. Zamani M, Neghab N, Torabian S. Therapeutic effect of *Vitex agnus castus* in patients with premenstrual syndrome. 2012.
117. Sadeghi T, Azimi A, Loripoor M. Comparing the effect of black Cohosh versus Vitagnus on the improvement of menopause symptoms. *The Iranian Journal of Obstetrics, Gynecology and Infertility.* 2019;21(12):1-10.
118. Gholami F, Samani LN, Kashanian M, Naseri M, Hosseini AF, Nejad SAH. Onset of labor in post-term pregnancy by chamomile. *Iranian Red Crescent Medical Journal.* 2016;18(11).
119. Kabiri M, Kamalinejad M, Bioos S, Shariat M, Sohrabvand F. Comparative study of the effects of chamomile (*Matricaria Chamomilla* L.) and cabergoline on idiopathic hyperprolactinemia: a pilot randomized controlled trial. *Iranian Journal of Pharmaceutical Research: IJPR.* 2019;18(3):1612.
120. Shoorei H, Khaki A, Ainehchi N, Taheri MMH, Tahmasebi M, Seyedghiasi G, et al. Effects of *Matricaria chamomilla* extract on growth and maturation of isolated mouse ovarian follicles in a three-dimensional culture system. *Chinese Medical Journal.* 2018;131(02):218-25.
121. Silva FV, Dias F, Costa G, Campos MdG. Chamomile reveals to be a potent galactagogue: the unexpected effect. *The Journal of Maternal-Fetal & Neonatal Medicine.* 2018;31(1):116-8.
122. Mari A, Montoro P, D'Urso G, Macchia M, Pizza C, Piacente S. Metabolic profiling of *Vitex agnus castus* leaves, fruits and sprouts: Analysis by LC/ESI/(QqQ) MS and (HR) LC/ESI/(Orbitrap)/MSn. *Journal of pharmaceutical and biomedical analysis.* 2015;102:215-21.
123. Youseflu S, Sadatmahalleh SJ, Mottaghi A, Kazemnejad A. Dietary phytoestrogen intake and the Risk of Endometriosis in Iranian Women: A case-control study. *International journal of fertility & sterility.* 2019;13(4):296.
124. Shimoyama Y, Hirabayashi K, Matsumoto H, Sato T, Shibata S, Inoue H. Effects of glycyrrhetic acid derivatives on hepatic and renal 11 $\beta$ -hydroxysteroid dehydrogenase activities in rats. *Journal of pharmacy and pharmacology.* 2003;55(6):811-7.
125. Shukla KK, Mahdi AA, Ahmad MK, Jaiswar SP, Shankwar SN, Tiwari SC. *Mucuna pruriens* reduces stress and improves the quality of semen in infertile men. *Evidence-Based Complementary and Alternative Medicine.* 2010;7(1):137-44.
126. Ahmad MK, Mahdi AA, Shukla KK, Islam N, Jaiswar SP, Ahmad S. Effect of *Mucuna pruriens* on semen profile and biochemical parameters in seminal plasma of infertile men. *Fertility and sterility.* 2008;90(3):627-35.
127. Shukla KK, Mahdi AA, Ahmad MK, Shankwar SN, Rajender S, Jaiswar SP. *Mucuna pruriens* improves male fertility by its action on the hypothalamus–pituitary–gonadal axis. *Fertility and sterility.* 2009;92(6):1934-40.
128. Sharma M, Chandokhe N, Ghatak BR, Jamwal K, Gupta O, Singh G, et al. Pharmacological screening of Indian medicinal plants. 1978.
129. Pulikkalpur H, Kurup R, Mathew PJ, Baby S. Levodopa in *Mucuna pruriens* and its degradation. *Scientific reports.* 2015;5(1):11078.
130. Saleem S, Muhammad G, Hussain MA, Altaf M, Bukhari SNA. *Withania somnifera* L.: Insights into the phytochemical profile, therapeutic potential, clinical trials, and future prospective. *Iranian journal of basic medical sciences.* 2020;23(12):1501.
131. Mahdi AA, Shukla KK, Ahmad MK, Rajender S, Shankwar SN, Singh V, et al. *Withania somnifera* improves semen quality in stress-related male fertility. *Evidence-Based Complementary and Alternative Medicine.* 2011;2011(1):576962.
132. Osman A, Yunos N, Adenan M. Determination of bioactive peptide (4.3 KDA) as an aphrodisiac marker in six Malaysian plants. *Journal of Tropical Forest Science.* 2007;19(1):61-3.
133. Varghese CP, Ambrose C, Jin S, Lim Y, Keisaban T. Antioxidant and anti-inflammatory activity of *Eurycoma longifolia* Jack, a traditional medicinal plant in Malaysia. *International Journal of Pharmaceutical Sciences and Nanotechnology.* 2013;5(4):1875-8.
134. Wahab NA, Mokhtar NM, Halim WNHA, Das S. The effect of *Eurycoma longifolia* Jack on spermatogenesis in estrogen-treated rats. *Clinics.* 2010;65:93-8.

135. Tambi M, Imran M, Henkel R. Standardised water-soluble extract of *Eurycoma longifolia*, Tongkat ali, as testosterone booster for managing men with late-onset hypogonadism? *Andrologia*. 2012;44:226-30.
136. Shukla KK, Mahdi AA, Ahmad MK, Shankhwar SN, Rajender S, Jaiswar SP. *Mucuna pruriens* improves male fertility by its action on the hypothalamus-pituitary-gonadal axis. *Fertil Steril*. 2009;92(6):1934-40. doi: <https://doi.org/10.1016/j.fertnstert.2008.09.045>
137. Ambiyé VR, Langade D, Dongre S, Aptikar P, Kulkarni M, Dongre A. Clinical Evaluation of the Spermatogenic Activity of the Root Extract of *Ashwagandha* (*Withania somnifera*) in Oligospermic Males: A Pilot Study. *Evidence-based complementary and alternative medicine : eCAM*. 2013;2013:571420. doi: <https://doi.org/10.1155/2013/571420>
138. Yadav A, Mishra RK. Exploring the role of *Withania somnifera* in male reproductive health: Insights from laboratory and clinical study. *Journal of Reproductive Healthcare and Medicine*. 2025;6:3. doi: [https://doi.org/10.25259/jrhm\\_27\\_2024](https://doi.org/10.25259/jrhm_27_2024)
139. Tambi MI, Imran MK. *Eurycoma longifolia* Jack in managing idiopathic male infertility. *Asian J Androl*. 2010;12(3):376-80. doi: <https://doi.org/10.1038/aja.2010.7>
140. Leisegang K, Finelli R, Sikka SC, Panner Selvam MK. *Eurycoma longifolia* (Jack) Improves Serum Total Testosterone in Men: A Systematic Review and Meta-Analysis of Clinical Trials. *Medicina (Kaunas)*. 2022;58(8). doi: <https://doi.org/10.3390/medicina58081047>
141. Roozbeh N, Amirian A, Abdi F, Haghdoust S. A Systematic Review on Use of Medicinal Plants for Male Infertility Treatment. *J Family Reprod Health*. 2021;15(2):74-81. doi: <https://doi.org/10.18502/jfrh.v15i2.6447>
142. Park HJ, Choe S, Park NC. Effects of Korean red ginseng on semen parameters in male infertility patients: a randomized, placebo-controlled, double-blind clinical study. *Chinese journal of integrative medicine*. 2016;22:490-5.
143. Walczak-Jedrzejowska R, Wolski JK, Slowikowska-Hilczek J. The role of oxidative stress and antioxidants in male fertility. *Central European journal of urology*. 2013;66(1):60.
144. Kolahdooz M, Nasri S, Modarres SZ, Kianbakht S, Huseini HF. Effects of *Nigella sativa* L. seed oil on abnormal semen quality in infertile men: a randomized, double-blind, placebo-controlled clinical trial. *Phytomedicine : international journal of phytotherapy and phytopharmacology*. 2014;21(6):901-5. doi: <https://doi.org/10.1016/j.phymed.2014.02.006>
145. M. Marbat M, Abid Ali M, M. Hadi A. The use of *Nigella sativa* as a single agent in treatment of male infertility. *Tikrit Journal of Pharmaceutical Sciences*. 2023;9(1):19-29. doi: <https://doi.org/10.25130/tjphs.2013.9.1.2.19.29>
146. Boroujeni SN, Malamiri FA, Bossaghzadeh F, Esmaeili A, Moudi E. The most important medicinal plants affecting sperm and testosterone production: a systematic review. *JBRA Assist Reprod*. 2022;26(3):522-30. doi: <https://doi.org/10.5935/1518-0557.20210108>
147. Fanaei H, Azizi Y, Khayat S. A review: role of oxidative stress in male infertility. *Journal of Advanced Biomedical Sciences*. 2013;3(2):93-103.
148. Barati E, Nikzad H, Karimian M. Oxidative stress and male infertility: current knowledge of pathophysiology and role of antioxidant therapy in disease management. *Cellular and Molecular Life Sciences*. 2020;77:93-113.
149. Khosrowbaki A. The role of oxidative stress in male infertility: A review. *Journal of Arak University of Medical Sciences*. 2013;15(9):94-103.