

Therapeutic potential of inositol to PCOS: An overview of administration, efficacy, and potential applications

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ABSTRACT

Inositol, a group of naturally occurring sugar alcohols, has gained attention for the diverse physiological roles and therapeutic potential. This comprehensive overview examines the administration, efficacy, and potential applications of inositol in various medical contexts. Myo-inositol and D-chiro inositol are the two types of inositol covered in this review, exploring their mechanisms of action and biochemical pathways. Discussions on the administration methods, including supplements and dietary sources, provide insights into optimizing therapeutic outcomes. The review also explores the available data on the effectiveness of inositol in treating diseases like mental health disorders, metabolic disorders, and polycystic ovarian syndrome (PCOS). Furthermore, potential reproductive medicine, neurology, and other areas of applications are explored. This overview provides a comprehensive snapshot of the evolving landscape of inositol research, emphasizing its promising role in various therapeutic interventions and prompting further exploration of its multifaceted benefits.

Keywords: inositol, physiological roles, administration, efficacy, PCOS, reproductive medicine

INTRODUCTION

Inositol, a fundamental sugar alcohol, has garnered substantial attention for its diverse physiological roles and potential therapeutic applications [1]. It is frequently referred to as a component of the vitamin B-complex, despite the fact that it is not strictly a vitamin, because the body can synthesize it. Inositol comes in numerous forms, the most well-studied of which are myo-inositol and D-chiro-inositol [2]. This comprehensive exploration aims to unravel the multifaceted nature of inositol by delving into its physiological roles, utilization, and the evolving landscape of research on its efficacy [3].

Physiological roles of inositol

As a vital constituent of cell membranes, inositol contributes significantly to the structural integrity and fluidity of lipid bilayers [4].

Inositol's derivatives, particularly inositol phosphates, actively participate in intricate cellular signaling

processes, playing pivotal roles in signal transmission within cells [4].

Inositol is a precursor to inositol triphosphate (IP₃), which is involved in releasing calcium from intracellular stores, an essential step in neurotransmitter signaling [4].

Myo-inositol has been studied for its potential role in insulin signaling, and some research suggests that it may positively impact insulin sensitivity [5].

Inositol, notably myo-inositol, are important in oocyte maturation and have been investigated for potential advantages in disorders such as polycystic ovarian syndrome (PCOS), [5].

Use of inositol

Supplements: Inositol is used as a dietary supplement, typically in the form of myo-inositol or a mix of myo-inositol and D-chiro inositol.

Additionally, inositol can be found in a variety of foods, including fruits, beans, nuts, and grains. How-

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Article History:

Received: 17 February 2024

Accepted: 28 March 2024

ever, the amounts obtained through a typical diet may be relatively small, prompting interest in supplementation [6].

Efficacy

Myo-inositol has been investigated for its effectiveness in enhancing ovarian function, insulin sensitivity, and hormonal balance in women with Polycystic Ovary Syndrome, more often in combination with D-chiro inositol [6].

Mood Disorders: Some research has investigated the potential significance of inositol in the treatment of mood disorders, including depression and anxiety. It is thought to influence neurotransmitter signaling pathways in the brain [7].

Metabolic and Neurological Disorders: Research on the potential advantages of inositol in neurological disorders including epilepsy and neurodegenerative ailments as well as metabolic disorders like metabolic syndrome and type 2 diabetes is still ongoing [8].

This overview aims to provide a comprehensive understanding of inositol's physiological significance, its utilization through supplements or dietary sources, and evolving scientific insights into its efficacy across various health domains, particularly in the reproductive health area.

INOSITOLS AND OVARIES

Inositol, particularly myo-inositol and D-chiro inositol, have been studied for their potential impact on ovarian function, particularly in the context of polycystic ovarian syndrome.

Polycystic Ovarian Syndrome (PCOS)

Polycystic Ovarian Syndrome is an endocrine disorder characterized by irregular menstrual periods, elevated androgen levels (male hormones), and the presence of ovarian cysts.

Inositol is involved in insulin signaling pathways and some individuals with PCOS exhibit insulin resistance. Myo-inositol, in particular, has been investigated for its potential role in improving insulin sensitivity.

According to research, inositol may improve ovarian function, leading to regular ovulation in women with polycystic ovarian syndrome.

Inositol supplementation, frequently a mix of myo-inositol and D-chiro inositol, has been investigated for its potential to restore hormonal balance, particularly the regulation of luteinizing hormone (LH), and follicle-stimulating hormone (FSH) [1].

Oocyte maturation

The role of Myo-inositol is implicated in oocyte maturation, a critical process for successful reproduction. It is involved in the regulation of various cellular

functions, including those related to egg development and quality. The myo-inositol supplementation may contribute to improved egg quality, which is particularly relevant for women undergoing assisted reproductive technologies (ART) [9].

Fertility and reproductive health

Inositol, especially Myo-inositol, have been associated with improved menstrual regularity in women with PCOS, potentially enhancing overall fertility. Also, inositol supplementation is being explored as a complementary approach in fertility treatments, with some studies investigating its role in enhancing the success of ART procedures [9].

Dosage and formulations

Research often focuses on the joint usage of myo-inositol and D-chiro inositol on specific ratios, as this combination is believed to mimic the physiological inositol ratio found in the ovaries. The optimal dosage of inositol for ovarian health may vary, and healthcare providers often tailor recommendations based on individual needs and responses [10,11].

It's crucial to note that while some research shows favorable outcomes, the field of inositol research concerning ovaries is continually evolving. Individuals considering inositol supplementation for reproductive health or PCOS should consult with healthcare professionals for personalized advice, especially if they are pregnant, breastfeeding, or have underlying health conditions.

INOSITOL AND POLYCYSTIC OVARIAN SYNDROME

Polycystic ovarian syndrome is an endocrine condition that affects women during their period of reproduction [12]. The main characteristics of PCOS include:

Ovulatory dysfunction: Women with PCOS frequently have irregular menstrual cycles or amenorrhea (lack of menstrual periods). Ovulation may be infrequent or absent, leading to difficulties in conceiving for those trying to become pregnant.

Hyperandrogenism: Increase in blood level of androgens (male hormones) like testosterone may be present in individuals with PCOS. This can manifest with symptoms like hirsutism (excessive hair growth), acne and male pattern hair loss.

Polycystic ovarian: The ovaries may be enlarged and contain numerous small follicles, giving them a "polycystic" appearance on ultrasound. Despite the name, not all individuals with PCOS have ovarian cysts, and only the presence of many cysts is insufficient for diagnosis.

In addition to these main characteristics, PCOS is frequently accompanied by a variety of metabolic

problems, such as insulin resistance, which can raise the risk of type 2 diabetes and cardiovascular disease. Other associated symptoms may include weight gain, difficulties in weight management, and skin changes.

The specific aetiology of polycystic ovarian syndrome is unknown, however, it is likely due to a mix of hereditary and environmental factors. Insulin resistance and hormonal abnormalities, such as high insulin and androgen levels, are common in women with polycystic ovarian syndrome.

PCOS is a syndrome, meaning it presents as a collection of symptoms that can vary widely among affected individuals. The diagnosis is typically made based on clinical and laboratory findings, and healthcare providers may use criteria established by organizations such as the Rotterdam criteria that demand the presence of at least two out of three key features (ovulatory dysfunction, hyperandrogenism, and polycystic ovaries) for diagnosis.

Management of PCOS often involves addressing specific symptoms and may include lifestyle modifications, hormonal treatments to regulate menstrual cycles, and interventions to manage associated conditions such as insulin resistance. Women with PCOS should collaborate with their healthcare professionals to create a personalized treatment strategy based on their individual symptoms and health needs [13].

Inositol, particularly myoinositol and D-chiro inositol, has been investigated for its potential therapeutic effects in managing PCOS symptoms. Women with PCOS frequently exhibit insulin resistance, which contributes to hormonal abnormalities and ovarian dysfunction. Myo-inositol has been investigated for its potential to increase insulin sensitivity. It may enhance the cellular insulin response, thereby helping to regulate blood sugar levels [14].

Also, Myo-inositol regulates menstrual cycles or ovulatory function. Inositol, generally in the form of myoinositol and D-chiro inositol, can restore the equilibrium between luteinizing hormone (LH) and follicle-stimulating hormone (FSH), which is frequently disrupted in PCOS. Inositol may influence follicular development and quality, potentially improving the chances of successful ovulation. Also, inositol contributes to a reduction in the number and size of ovarian cysts.

By addressing insulin resistance and hormonal imbalances, inositol may contribute to improved menstrual regularity and increased fertility in individuals with PCOS. Inositol supplementation has been explored as a complementary approach in fertility treatments, with some studies investigating its role in enhancing the success of assisted reproductive technologies [14].

THERAPEUTIC POTENTIAL OF INOSITOL

There is still no clear consensus on inositol dosage or which inositol isoform is more effective in treating symptoms and metabolic profiles in PCOS.

D-chiro-inositol 1,200 mg once daily for eight weeks in overweight and obese women with PCOS improved ovulatory function, reduced testosterone levels, decreased insulin resistance, improved metabolic parameters, and reduced systolic and diastolic blood pressure and triglyceride levels [15].

In overweight women with PCOS, Myo-inositol 2g daily combined with folic acid produces insulin sensitizers equivalent to metformin [16].

In PCOS women, combining Myo-inositol 4 g daily with D-chiro-inositol 1 g daily resulted in a drop in circulating androgen levels, LH, and the LH/FSH ratio, as well as an increase in SHBG [15].

Inositol, when used within recommended dosages, has shown good safety profiles and is generally well-tolerated. This makes it a favorable option for individuals with PCOS seeking adjunctive treatments for reproductive health.

Many other comparative studies have been done between these two inositol isoforms, but there is still no standardized dosage, so further research is required that will contribute to this issue.

NEW PERSPECTIVES IN MANAGEMENT OF PCOS WITH INOSITOL

The exploration of inositol in the context of polycystic ovarian syndrome has introduced novel perspectives and potential therapeutic avenues [17].

Insulin resistance is a typical characteristic of PCOS, contributing to hormonal imbalances and metabolic disturbances. Inositol, particularly myo-inositol, has emerged as a potential insulin sensitizer. Studies suggest that it may improve cellular insulin response, addressing insulin resistance and its associated effects on hormonal regulation [18].

Both myoinositol and D-chiro inositol are crucial inositol iso-forms found in the ovaries, and their balance is thought to be essential for normal ovarian function. Recent research has focused on understanding the physiological inositol ratio in the ovaries. Some formulations combine myoinositol and D-chiro inositol in specific ratios to mimic this physiological balance, potentially enhancing therapeutic outcomes [19].

Hormonal imbalances, including elevated luteinizing hormone and disrupted follicle-stimulating hormone ratios, are common in polycystic ovarian syndrome. The forms of inositol, especially in combination, have been studied for their potential to restore a more balanced LH/FSH ratio, addressing one of the hormonal challenges in PCOS [20].

Irregular ovulation or anovulation is a hallmark of PCOS, contributing to fertility challenges. Inositol, particularly myo-inositol, has been investigated for their role in promoting regular ovulatory cycles. This could have an impact on increasing fertility and reproductive outcomes in women with polycystic ovary syndrome.

Polycystic ovary syndrome is a heterogeneous disorder with varying symptoms and presentations. Inositol supplementation allows for a more personalized approach to PCOS treatment. Healthcare providers can consider individual needs and responses when recommending specific formulations and dosages of inositol.

Lifestyle modifications, including diet and exercise, are key components in managing PCOS. Inositol can complement lifestyle interventions, offering a multifaceted approach to address both metabolic and hormonal aspects of PCOS management [21,22].

In a general overview, the evolving research on inositol in the context of PCOS brings forth new perspectives on its potential as a therapeutic agent. The focus on insulin sensitization, inositol ratios, impact on hormonal balance, and individualized treatment approaches underscores the dynamic nature of inositol research and its implications for improving the management of PCOS. As the field continues to advance, further insights into the intricate mechanisms

of inositol action in PCOS may pave the way for more targeted and effective treatment strategies.

CONCLUSIONS

In conclusion, the accumulating evidence suggests that the forms of inositol hold promise in the management of PCOS, infertility, and reproductive health. The multifaceted effects on insulin sensitivity, hormonal balance, and ovarian function underscore the potential of forms of inositol as valuable additions to the therapeutic range for women with PCOS looking to increase their fertility and reproductive outcomes. However, individual responses may vary, and further research is warranted to refine treatment protocols and understand the long-term effects of inositol supplementation in this context. However, women should consult with healthcare professionals for personalized advice based on their specific health needs and circumstances.

Informed consent: N/A

Ethics approval: This study is a literature review. An institutional ethics board approval was not necessary.

Disclosure of interests: The author declares that they have no financial and conflict of interest.

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