

Rapid Literature Review on Ashwagandha and Cortisol

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Abstract—For century, Ashwagandha (*Withania somnifera*) is used as Ayurvedic Medicine.[4] It is traditional herb that known for its ability to help in flexibility and balance, more specific in treating stress and psychosomatic disorders. It has ability to lower the cortisol, which body's main stress hormone, it has gained more attention recently due to modern research. [1,2,11] This is quick review on the effect of Ashwagandha in maintaining cortisol in the body to control the stress. This review evaluates how Ashwagandha influence cortisol level in people whomever experiencing high stress.

Taking Ashwagandha supplement daily could significantly lower the cortisol level often by 20-30% in the patient having chronic stress. [1,12] It shows effect as reduction of stress. The reduction of level of cortisol in body is observed after consistently taking Ashwagandha supplement over four to twelve weeks in which daily doses in the range of 300 and 600 mg. [1,3,10] Participants reported benefits in anxiety, sleep quality, and overall mental health in addition to reductions in cortisol levels. The study shows the treatment is safe, with few mild sides effect reported. [11]

It is important to recognize that some trials use different study designs and small sample sizes or extract formulations that could influence the consistency of results [11,13] to better understand the long-term effects, mechanism of actions, and what populations may benefit the most from the use of Ashwagandha, and larger trials are necessary, though the preliminary findings are promising. While Ashwagandha shows promising result as natural stress reliever, we're still learning how to use it more effectively and for whom it works best.

Index Terms—Ashwagandha, *Withania somnifera*, cortisol regulation, stress management, adaptogens, hypothalamic-adrenal-pituitary (HPA) axis, clinical trials

I. INTRODUCTION OF ASHWAGANDHA

Ashwagandha which scientific name is *Withania somnifera*, it is also called Indian Ginseng or winter cherry. [4] It commonly called by Ashwagandha which is a Sanskrit name, it gets the name

Ashwagandha because the plant root is smell like wet horse ("Ashwa" for horse and "Gandha" for smell) It is a key medicinal plant in Ayurveda for their benefits in promoting vitality, longevity, and mental well-being. [9] In Ayurveda it has been used in for restoring strength, managing stress and supporting reproductive health. [4]

the most studied clinical effect of Ashwagandha is its role in Modulating the stress hormone cortisol. If the cortisol level gets elevated it get result in poor cognitive and physical performance. [6,7] In a numerous randomized controlled trial, the standardised Ashwagandha roots extract has shown dramatically lower serum cortisol. [1,2,3] Which enhance stress resilience, anxiety symptoms, and general quality of life [1,10]

Ashwagandha is promising herbal remedy for stress-related conditions and cortisol management. we can maximize dosage, safety and long-term advantages Through the rigorous clinical research.

II. WHAT IS CORTISOL

The adrenocorticotrophic hormone (ACTH) of pituitary gland Stimulates the adrenal cortex of the adrenal gland to create the steroid hormone cortisol. [5] It is primary human glucocorticoid and is essential for the body's reaction to stress.

Cortisol often known as 'stress hormone' is released by the adrenal glands when the body experience physical or emotional challenges. It is part of hypothalamic pituitary adrenal (HPA) axis, which is a natural stress response system that help us handle challenging situation. [5,6]

Cortisol Roles in the body:

2.1 Metabolic regulation: cortisol helps the liver in gluconeogenesis to maintain consistence energy supply, especially during fasting or stressful times. It also controls how proteins and fats are Broken down and convert into energy. [6]

2.2 Immune modulation: Cortisol keep the immune system balanced. it lowering the cytokine production to reduce unnecessary inflammation and help to stop the immune system from overreacting. [6]

2.3 Cardiovascular support: it makes sure blood vessel function properly and help to maintain normal blood pressure. [6]

2.4 Stress adaptation: Cortisol help body to react quickly to stress and then return to normal once the situation get pass. [6]

In chronic stress the cortisol level gets high for too long period, which can lead to issues like anxiety, fatigue, high blood pressure, and weakened immunity. [7]

III. THE HPA AXIS AND STRESS RESPONSE

The hypothalamic pituitary adrenal (HPA) axis is the body's main stress response system. [5] It works as when your brain communicates with your adrenal gland to release cortisol, which help you manage stress and maintain equilibrium. The HPA axis is similar to your body's natural warning system.

3.1 The Role of the HPA Axis and Cortisol

When the brain detects a stressful situation, it tells the hypothalamus to release a hormone called corticotrophin-releasing hormone (CRH). This hormone then signals the anterior pituitary gland to make and release another hormone called adrenocorticotrophic hormone (ACTH) into the bloodstream. ACTH produces in the adrenal glands. it stimulates the adrenal cortex to produce and release cortisol. the body's main stress hormone. [5]

Cortisol serves several key functions during times of stress. It increases blood sugar levels by encouraging glucose production and providing quick energy to assist the body in reacting. It also slowly reduces inflammation to keep the immune system from overreacting. Furthermore, cortisol helps in regulating blood pressure and enhances blood circulation to the main organs. It even sharpens cognitive function, increasing alertness and focus so that you can respond quickly to immediate dangers. After the stressful event has passed, cortisol instructs the brain to decrease the output of CRH and ACTH, helping the body to relax and revert to its usual balanced state. [5,6]

IV. MOA OF ASHWAGANDHA

4.1. Direct HPA Axis Modulation to Reduce Cortisol
Ashwagandha reduces stress by calming the HPA axis, the body's stress mechanism. The hypothalamus and pituitary gland in the brain control this system, which instructs the adrenal glands to release the stress hormone cortisol. According to studies, Ashwagandha can lower cortisol levels in stressed individuals, most likely by reducing the signals (CRH and ACTH) that cause the synthesis of cortisol. [1,8] Simply said, it reduces stress by blocking the brain's stress signals, which keeps your body from being overly stressed.

4.2. Restoring Cortisol's Negative Feedback Sensitivity

Ashwagandha aids in reducing the body's stress reaction. Your body often releases the stress hormone cortisol while you're under stress. A feedback loop that regulates this hormone instructs your brain to cease generating stress signals (CRH and ACTH) as soon as the tension is ended. An excessive amount of cortisol in your body might be harmful if this system remains "on" for an extended period of time. After stress, Ashwagandha helps your body's feedback system function normally again, allowing your cortisol levels to return to normal and avoiding long-term problems. [8]

4.3. Neurotransmitter Modulation for Calming Effects
Withanolides and glycosides this are the two substances found in Ashwagandha, have an impact on neurotransmitters. which include acetylcholine, serotonin, GABA, and others. [2] These substances aid in brain relaxation and the reduction of stress and anxiety. You can feel less anxious overall by reducing the brain's stress signals (CRH) by increasing GABA, which calms the brain, and modifying serotonin and acetylcholine, and overall, this may influence mood and stress. [2]

4.4. Anti-Inflammatory Actions to Lower HPA Activation

Ashwagandha aids in lowering inflammation and the body's damage caused by dangerous chemicals known as free radicals. Higher cortisol levels can result from inflammation, which is brought on by chemicals like IL-1 and IL-6. This inflammation can also increase the activity of the body's stress system, or HPA axis.

Ashwagandha soothes this stress mechanism by reducing inflammation and oxidative stress, which lowers cortisol levels and lessens physiological stress in general. [8]

4.5. Antioxidant Effects to Reduce Cellular Stress Signals

Withanolides are natural compounds in Ashwagandha that act like small stress managers inside our cells. They help to maintain certain stress-control pathways in the brain, such as (NF- κ B and heat-shock proteins) NF- κ B is a protein complex in cells that controls inflammation and stress responses and Heat-shock proteins are molecules that help protect cells by

keeping these systems balanced, Ashwagandha helps the body remain calm under pressure and prevents the stress response from going into overstimulate. [8,9]

4.6. Clinical Evidence Supporting Cortisol Reduction Verification by a clinician Ashwagandha administration significantly lowers blood cortisol, lowers perceived stress and anxiety ratings, and enhances resilience and sleep quality, according to numerous RCTs and recent meta-analyses. [3,11,12] These results are consistent with the above-mentioned mechanisms.



V. HISTORIC APPLICATION OF ASHWAGANDHA

Before modern science began studying cortisol and the HPA axis, Ashwagandha had already established a prominent place in traditional medicine, especially in Ayurveda, India's ancient medicinal system. Ashwagandha, which translates to "strength of the horse" in Sanskrit, was prized for its ability to boost immunity to mental and physical stress as well as vitality and stamina. It is a rejuvenating tonic, which is used to increase lifespan, strengthen immunity, enhance sleep, enhance memory according to Ayurvedic texts. It is clearly mention in charaka Samhita and sushruta Samhita. In charaka Samhita Ashwagandha was listed as a "RASAYANA" (rejuvenating tonic) [4,9]

Ashwagandha was once widely used by traditional healers to treat patients who felt exhausted, nervous, or exhausted following a medical procedure. They considered it a unique type of herb, one that could both restore physical strength and soothe a restless mind. Many of those same problems may now be recognized as indicators of cortisol imbalance or chronic stress. Recent studies have demonstrated that Ashwagandha can help control cortisol levels and enhance the body's capacity to reduce with stress, providing scientific validation for what traditional healers may have known all along. [1,4] And Ashwagandha is the major name in traditional healer.

VI. MODERN RESEARCH TRENDS

Ashwagandha has gained popularity among researchers, physicians, and wellness lovers in recent

years. This plant, which is considered a potent adaptogens, is believed to assist the body in managing various forms of stress, including environmental, emotional, and physical stress. Recent research on it shows the positive results on the body's stress system, particularly its ability to balance the hypothalamic-pituitary-adrenal (HPA) axis and regulate cortisol level which is a crucial stress hormone and is has contributed to its growing popularity. [1,11,12] People all around the world who seek a plant-based option to manage stress, sleep better, feel more energized, and maintain their health are turning to Ashwagandha as their common natural supplement. Scientists are studying Ashwagandha's key ingredients, like withanolides in labs and with people to prove the health benefits that peoples have believed in for a long time. [8,9]

VII. ASHWAGANDHA AND CORTISOL: CLINICAL TRIAL OVERVIEW:

Many studies have examined the potential benefits of Ashwagandha supplements for adults who are experiencing chronic stress. For roughly six to eight weeks, participants in these legitimate randomized controlled studies ingested standardized extracts from the plant's root, typically ranging from 300 to 600 mg daily. [1,3] The results were quite consistent. people's levels of the stress hormone cortisol decreased noticeably as compared to those receiving a placebo. [1,12,14,17] Additionally, they reported feeling happier, less stressed, and generally better off. [1,3] The way it works comes down to compounds called withanolides found in Ashwagandha. These compounds appear to help calm the body's stress response system by reducing those overactive stress signals. [8] As it also be examined in the many clinical trial studies. The effect of the Ashwagandha supplement in balancing cortisol levels and may result in improved sleep, more focused thinking, and even some support for metabolism. Although many of the studies were relatively small and we still lack reliable data on long-term safety, the evidence from these trials suggests that Ashwagandha is a promising natural option for stress management and cortisol regulation overall. [11,17] but, larger and more precise quality trials are required to fully confirm the benefits. It determines the optimal dosages, and comprehend how it works for various individuals. [11,13]

VIII. KEY FINDINGS FROM THE LITERATURE

Ashwagandha shows an effect in helping people manage their stress. Proving in participants which randomly randomized either Ashwagandha or a placebo, taking 300–600 mg of Ashwagandha root extract daily for 6-8 weeks will lower cortisol, [1,3,12,14] Stress and anxiety levels are drop together with cortisol. [1,2] Beyond lowering stress, Ashwagandha also have other advantages to like the research participants usually report deeper and more restorative sleep, which improved sleep quality. [3,10] Some people also report feeling refreshing and able to think more clearly. [2] The withanolides promote brain function, reduce inflammation, and calm the body's stress response are probably the source of these benefits. [8]

Research that combines the results of various research provides compelling evidence that Ashwagandha is effective in reducing stress and its associated issues. [11,17] The problem is that many of these studies are tiny, short, or employ multiple types of Ashwagandha extracts, making it difficult to determine the ideal dosage or how it affects each individual. [11,13] Overall, it appears to be rather safe, but more extensive, long-term research is still required to determine the optimal administration. Overall, Ashwagandha appears to be a great natural remedy for stress management, improved sleep, and a more balanced feeling. It's a great choice if you're looking for a natural way to feel better because it combines traditional herbal knowledge with modern technology.

IX. STUDY DOSAGE AND DURATION

When you look at clinical Research on Ashwagandha and cortisol, the main key points that stand in front of us is dosage and duration of treatment, the most well-designed trial studies have used standardised root extract in the range of 300-600 mg per day, this usually taken in capsule form. [1,3] The duration of treatment in studies is generally six to eight weeks, and it was long enough to observe meaningful changes in stress level and cortisol balance. [1,11]

For example, in the taken study, they conducted a double blinded, placebo-controlled study where 64

adults with chronic stress were given 300 mg of Ashwagandha root extract twice a daily (600 mg total) which given for 60 days. The observed result shows a significant reduction in serum cortisol (-27.9%), and also improved a stress and anxiety score compared to placebo.

Also, in another study 300 mg of Ashwagandha extract twice daily in adult under stress for 8 weeks. they reported not only lower cortisol level but also better sleep quality and improve overall emotion.[3]

Study	Participants	Dosage & Duration	Key Outcomes
Chandrasekhar et al., 2012	64 adult with chronic stress	300 mg root extract twice daily (600 mg/ day) for 60 days	Lower serum cortisol by 27.9%, lower stress and anxiety scores, improved well-being
Salve et al., 2019	Healthy adults under stress	300 mg root extract twice daily (600 mg /day) for 8 weeks	Lower cortisol levels, improved sleep quality, decrease stress, enhance overall well-being

By looking across these studies, the trend is quite consistent: Daily dose of 300-600 mg for about two months likely to lower cortisol and improve stress resilience. [1,3,12] While the result is promising, in most of the trial, sample size is relatively small. [11] So, to confirm the safest and most effective dosage strategy, longer term research is required. [11,13]

X. SAFETY OVERVIEW AND ADVERSE REACTIONS

10.1 Safety Profile of Ashwagandha

Ashwagandha in most of people, it's generally safe when it taken in typical dose around 300-600mg per day of standardised root extract for short period, around 6 to 12 weeks. various studies of randomized controlled trial, shows that most of the people tolerate it well with minimal side effects. [1,3]

10.2 Reported Adverse Event in Clinical Trials

In any clinical studies the side effects from Ashwagandha are usually mild and temporary, often similar to what people experience with placebo, Common are:

- Mild stomach issue, like upset stomach, diarrhoea, or nausea
- Headaches
- Feeling sleepy (when higher dose)
- Increased appetite or Weight gain

Serious side effects are rare. Like in the studies of Chandrasekhar et al. and salve et al. found no major issues and review by Lopresti and their colleagues confirmed that side effects are typically mild and resolve on their own. [1,2,3,11]

Study	N(Population)	Dose and Duration	Reported Adverse Effect	Serious AE's	Notes
Salve et al.	60 (stress adult)	300 mg root extract BID (600 mg/day), 8 weeks	Mostly mild GI complaint, no clinically lab change	None reported	Improved sleep quality and wellbeing alongside with decreased cortisol
Chandra sekhar et al.	64 (chronic stress)	300 mg root extract BID (600 mg/day), 60 days	Mild GI upset, Headache	None reported	Significant decreased serum cortisol (-27.9%), high compliance
Pratte et al.	5 RCTs summarized	Typical 240-600 mg/day, 6-12 weeks	Typical 240-600 mg/day, 6-12 weeks' transient. GI upset, headache	None linked to study drug	Concluded favourable tolerability vs placebo in anxiety/stress trials.
Lopresti et al.	Multiple RCTs	Predominantly 300-600 mg/day, 6-12 weeks	Mild, self-limiting AEs, eates similar to placebo	None consistent across trials	Overall, Ashwagandha "appears safe" in short-term use, more long-term data needed.

10.3 Caution and Special Considerations

Generally, Ashwagandha is safe to consume but some group should concern with doctor before have it.

- Pregnant or Breastfeeding Woman: Traditional Ayurvedic wisdom advises against using Ashwagandha during pregnancy, and there's not

enough modern research that confirm that its safe for mother. [11]

- People with Thyroid issues:

Ashwagandha might boost the thyroid hormone level in body. So, if you have an overactive Thyroid then its best to avoid using it without medical guidance. [11]

- Those with autoimmune diseases:

Since Ashwagandha can affect the immune system, so that it is not suitable for the people with conditions like lupus or rheumatoid arthritis, or those who taking immunosuppressant drugs. [11]

- Medication interactions:

Ashwagandha can increase the effect of sedative, anti-anxiety medicines, thyroid treatment, or blood pressure medication. If you are using any of these, consult with your doctor before starting of Ashwagandha. [11]

Ashwagandha is generally well suitable for short term use like (6-12 weeks) at modern doses, with only mild and temporary side effect reported in most cases. Serious issues are rare in well-designed studies. However, we still need more detailed and structured research on its safety for long term use (beyond 6 months). [11,13] If anyone considering Ashwagandha, especially if they come under one of these groups, then they should talk with the healthcare provider to make sure it's right for them.

XI. CURRENT RESEARCH LIMITATIONS

The research on Ashwagandha and its effect on cortisol is positive, but at same time there are some critical gaps we can't ignore, in that one of the biggest issues is that most of the studies are smaller often with the 100 people. With this limitation it's hard to configure that the benefits apply to everyone, especially group like older adult, people with ongoing health conditions, or those from different cultural backgrounds. [13]

Another challenge is that most of the studies are duration of six to eight week. [11] Which are long enough to show the short-term improvement in stress and cortisol, but not enough to show whether Ashwagandha is safe and effective in long term run. Since stress is usually long-term issue, this kind of research is required.

There is also the question of biasness in the research. Some studies are funded by supplement companies,

which highlight the concern about conflict of interest. [11,13] Plus, the way Ashwagandha is made is not always the same. Different studies use a different part of the plant (root, leaf), this will vary on the extraction method of the research thus this makes the result more complicated. [11]

On the final words, many studies rely on the peoples own experience and the effect of the stress and well-being. While this insight matters but they can be subjective. the use of more objective tools like biological marker and standardized test. His would make result more reliable. [13]

XII. STUDIES OF COMPARISON – HOW ASHWAGANDHA STACK UP AGAINST OTHER STRESS RELIEF REMEDIES

Ashwagandha is most commonly used Ayurvedic herb, But There are other herbs that people used instead of Ashwagandha to improve their ability to control stress. Other natural medicine that has been used for generations, such as Panax ginseng, Rhodiola Rosea, and Holy basil (Tulsi) are used for century, and now they have been studied in modern research. [15,16] When we compare Ashwagandha with other adaptogens then we get a clear picture of the strength of the Ashwagandha.

Various studies suggest that Ashwagandha have stronger and direct effect on the lowering cortisol than other adaptogens. [12,17] For example – Rhodiola rosea is well known for increasing concentration and reducing weariness, while panax ginseng is valued for boosting resilience and energy. [15] However, there effect on cortisol regulation is often mild and less persistent. Ashwagandha has more clinical data to support their potential to lower cortisol levels than holy basil, [16,17] because Ashwagandha effectiveness is documented in Ayurvedic literature, holy basil is also the Ayurvedic herb that has been demonstrate to benefit mood and anxiety. [16]

While, many Adaptogenic herbs supporting stress resilience in their own ways, Ashwagandha has the most consistent clinical evidence for directly lowering cortisol level. [12,17,18] This makes Ashwagandha strong candidate for the individual seeking a natural supplement to manage stress with lower risk especially when compared head-to-head with popular remedies.

XIII. POTENTIAL GROUPS THAT STAND TO GAIN THE MOST

While Ashwagandha shows effect on many demographic populations, in which some groups get benefit more from its capacity in lowering cortisol and stress compared to other adaptogens, from that one category is the people who experience chronic stress. Long term elevated cortisol levels are common in this individual, raising the risk of heart disease, anxiety, fatigue and sleep disturbances. [7] In the Clinical research it's proven that taking Ashwagandha supplement can help people who is under stress. [1,12] Participants are reported feeling having better sleep, feeling happier and also lowering in their cortisol level. [1,3] For those individuals Ashwagandha is the perfect herb which offer a safe and natural means of remaining balance in their daily life.

Another group that could gain a lot is the elderly population, as people age increases their ability to manage the cortisol level often declines, and high cortisol level in the body which arises the memory problem, insomnia, weekend immunity and decrease ability to fight off illness. [7] Ashwagandha has ability to improve cognitive function, reduce inflammation and promoting sound sleep that makes Ashwagandha promising for older peoples. Previous study states that Ashwagandha can aid with age related weariness and weakness, which at the end supporting its role in healthy aging.

The persons having chronic stress, mental exhaustion and irregular sleep are contributing in lifestyle related problems. This includes shift workers, students facing academic pressure, and people in high stress jobs. Ashwagandha can help in these groups by boosting energy. Improving sleep and balancing the HPA axis. [1,2,3] It supports their flexibility, focus and overall wellbeing. Ashwagandha is especially beneficial for those who are particularly vulnerable to negative effect of stress, rather than just being a general health supplement. This is correct for especially adult who experiencing chronic stress, and have many daily responsibilities, or are older and seeking more liveliness.

XIV. SUGGESTIONS FOR FURTHER RESEARCH

The credibility of Ashwagandha in cortisol regulation was admired by the researchers even though there are several gaps in the research need to be addressed. Which are discussed follows. [11,13,17,18]

14.1 Duration of studies

Most of the trial are carried are last for 6-12 weeks. [11] which is small duration studies as compare to other studies, it cannot satisfy the level and accuracy of the long term and detailed studies, on the Ashwagandha long term studies are required to evaluate the sustained effectiveness and safety, especially in chronic stress. [11,13]

14.2 Sample Size and Diversity

Many studies of Ashwagandha involve less than 100 participants. [11] Which is very low for the research study and it also effect on the outcome of the result. For the more precise and accurate result larger, multi-centre trial should conduct which includes a more diverse population, such as elderly population, patient with chronic diseases and people from different cultural and geographic backgrounds. [13]

14.3 Mechanistic insights

While Ashwagandha's role in stress reduction is recognized, the underlying biological mechanisms remain unexplored in their research. [8,13] It is the core thing that gives the broader perspective about the research. future studies should investigate how bioactive compounds like withanolides interact with the HPA axis, neurotransmitter, and inflammatory pathways. [8,18]

14.4 Bias and Funding Concerns

A number of existing studies are funded by supplement manufacturer, for their interest, and that raising the risk of bias in the research because the research will show the result that benefitted only the supplement manufacturer. [11,13] In this area independent, publicly funded and peer-reviewed studies are required to validate the findings and ensure objectivity. [13,18]

XV. CONCLUSION

Ashwagandha has the most promising Adaptogenic herb for managing stress, and it's proven in many research study. [1,11,12] Most of clinical evidence consistently shown improvement in stress resilience, sleep quality, mood and overall well-being, [1,2,3]

most of studies are short term, generally it is safe dosage of 300-600 mg daily, [11] further large scale, long term and independent trial are needed to confirm its safety, efficacy, and optimal dosage. [11,13,18] Overall, Ashwagandha is a bridge to the traditional wisdom with modern science as a natural remedy for stress and cortisol management.

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