

Formulation and Evaluation of herbal chocolate for treating hormonal imbalance

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ABSTRACT –

Hormonal imbalances are increasingly prevalent due to stress, lifestyle changes, and environmental factors, especially among woman of reproductive age. The present study focuses on the formulation and evaluation of a novel herbal chocolate incorporating withaniasomnifera (Ashwagandha) to address hormonal irregularities naturally. Ashwagandha, a well – known adaptogenic herb, is recognized for its potential to modulate cortisol levels and support endocrine function.

The prepared formulation was evaluated for its organoleptic properties, stability, and consumer acceptability. Preliminary observations indicated a favorable response in terms of palatability and shelf – life. The study suggests that herbal chocolates could serve as a convenient and appealing delivery system for herbal remedies, offering an alternative route for promoting hormonal balance through functional foods. Further clinical evaluations are recommended to validate the therapeutic efficacy of the formulation

I. INTRODUCTION

1.1 INTRODUCTION OF HORMONAL IMBALANCE:-

Hormonal imbalance occurs when there is too much or too little of a hormone in the bloodstream. Hormones are chemical messengers produced by glands in the endocrine system, and they regulate various bodily functions, including metabolism, growth, mood, reproductive health, and sleep. Even small changes in hormone levels can cause significant effects on the body.

Hormonal imbalances can affect both men and women and may result from various factors such as stress, poor diet, medical conditions pregnancy, menopause, or certain medications. Common symptoms include weight gain or loss, fatigue, mood swings, irregular periods, infertility, acne, and changes in appetite or sleep patterns.



Fig No. 1 The conceptual illustration of hormonal imbalance

Treatment depends on the underlying cause and may include lifestyle changes, medication, hormone therapy, or dietary adjustments. Hormonal imbalance can be triggered by multiple factors, including:

1. Stress and Lifestyle Factors: -Chronic stress leads to excess cortisol production, disrupting reproductive hormones like estrogen and progesterone. Poor diet, lack of exercise, and irregular sleep patterns negatively impact insulin and thyroid hormone levels.

2. Polycystic Ovarian Syndrome (PCOS): -PCOS is a major hormone-related disorder in women, characterized by high androgen levels, insulin resistance, and irregular ovulation. It affects 10-15% of women of reproductive age and is a leading cause of infertility.

3. Insulin Resistance and Blood Sugar Imbalance: - High insulin levels can trigger excess testosterone production, worsening conditions like PCOS. Uncontrolled insulin resistance can lead to diabetes and obesity, both of which affect hormone regulation.

4. Thyroid Disorder: -Hypothyroidism (low thyroid hormone levels) slows metabolism, causing fatigue, weight gain, and menstrual irregularities.

Hyperthyroidism (excess thyroid hormones) can lead to anxiety, rapid heartbeat, and weight loss.

5. Environmental Toxins and Endocrine Disruptors: - Chemicals found in plastics, pesticides, and processed foods (like BPA and phthalates) mimic hormones, leading to estrogen dominance and fertility issues.

1.2 POLYCYSTIC OVARIAN SYNDROME (PCOS): Polycystic ovarian syndrome (PCOS) is one of the most common endocrine disorders affecting women of reproductive age. It is a complex condition characterized by hormonal imbalances, irregular menstrual cycles, and the presence of multiple small cysts in the ovaries. PCOS is a leading cause of infertility and is associated with metabolic disturbances such as insulin resistance, obesity, and an increased risk of type 2 diabetes and cardiovascular diseases.

The condition is named "polycystic" because ultrasound imaging often reveals numerous small, fluid-filled sacs (follicles) on the ovaries. However, not all women with PCOS have ovarian cysts, and the presence of cysts alone is not enough for a diagnosis. Instead, PCOS is diagnosed based on a combination of symptoms, hormonal levels, and medical history.

Causes of PCOS: -Although the exact cause of PCOS remains unclear, researchers believe that a combination of genetic, hormonal, and environmental factors contribute to its development.

1. Genetic Factors: -PCOS tends to run in families, suggesting a hereditary component. Studies indicate that multiple genes, rather than a single gene, contribute to the condition.

2. Hormonal Imbalance: -PCOS is characterized by an overproduction of androgens (male hormones such as testosterone), which disrupts the normal function of the ovaries. This hormonal imbalance prevents the regular release of eggs, leading to irregular ovulation.

2. Insulin Resistance and Hyperinsulinemia:-

Up to 70% of women with PCOS have insulin resistance, meaning their cells do not respond effectively to insulin.

High insulin levels stimulate the ovaries to produce more androgens, worsening symptoms like hirsutism (excess hair growth), acne, and irregular periods. Insulin resistance is also linked to obesity, which can exacerbate PCOS symptoms.

4. Chronic Inflammation: -Low-grade inflammation is often present in women with PCOS and may contribute to increased androgen production. Inflammation is also linked to metabolic disorders such as obesity, diabetes, and cardiovascular disease.

5. Environmental and Lifestyle Factors: -Diet, physical activity levels, exposure to endocrine-disrupting chemicals (such as plastics and pesticides), and stress may influence PCOS development and severity.

Symptoms of PCOS: - The symptoms of PCOS can vary widely in type and severity. Some women experience only mild symptoms, while others have severe manifestations that affect their overall health and fertility.

1. Menstrual Irregularities: -

- Infrequent, prolonged, or absent menstrual cycles.
- Some women may experience heavy bleeding when they do get their period.

2. Hyperandrogenism (Excess Male Hormones):

- Acne, oily skin, and dandruff.
- Excessive hair growth (hirsutism) on the face, chest, back, or thighs.
- Male-pattern baldness or thinning hair.

3. Polycystic Ovaries: -

- The ovaries may appear enlarged with multiple small follicles on ultrasound.
- However, not all women with PCOS have visible ovarian cysts.

4. Metabolic Issues: -

- Weight gain, particularly around the abdomen.
- Difficulty losing weight.
- Increased risk of type 2 diabetes and metabolic syndrome.

5. Infertility and Ovulatory Dysfunction: -

- PCOS is one of the most common causes of infertility due to irregular ovulation or lack of ovulation.

6. Skin Change:-

- Acanthosis nigricans (dark, velvety patches of skin, often on the neck, underarms, or groin).
- Skin tags (small, flesh-colored growths).

7. Psychological Effects: -

- Increased risk of anxiety, depression, and low self-esteem.
- Mood swings and emotional distress due to hormonal imbalances and body image concerns.

Complications of PCOS: -If left untreated, PCOS can lead to several long-term health complications, including:

- ❖ Type 2 diabetes and gestational diabetes.
- ❖ High blood pressure and heart disease.
- ❖ Sleep apnea.
- ❖ Endometrial hyperplasia and increased risk of endometrial cancer.
- ❖ Non-alcoholic fatty liver disease (NAFLD).

Ovulation Disorders, Infertility, and the Role of Herbal Formulations:

-Ovulation is when a woman's ovary releases an egg (oocyte) typically every 28 days. If a woman's ovaries do not produce an egg or something else interrupts this process, she will have problems becoming pregnant. This is called infertility. If the women have irregular periods, you may have a condition called polycystic ovarian syndrome (PCOS). PCOS is when a hormonal imbalance causes your ovaries to enlarge and develop small cysts on the outer edges. Ovulation disorders are one of the leading causes of female infertility and occur when ovulation is disrupted or absent. They present as irregular or absent periods and can be confirmed with a blood test. Hormonal imbalance three main factor affecting in the body stress, hormonal, and sugar metabolism. Three main drugs for use in chocolate formulation Ovulation disorders and infertility. Ovulation disorders are a common cause of infertility in women. Allopathic medicine may cause various disorder Herbal formulations mean a dosage form consisting of one or more herbs or processed herbs in specified quantities to provide specific nutritional, cosmetic benefits meant for use to diagnose, treat, mitigate.

1.3 INTRODUCTION TO HERBAL CHOCOLATE:

-Hormonal imbalance is a prevalent health concern that affects individuals across different age groups, leading to various physiological and psychological issues such as irregular menstruation, mood swings, weight fluctuations, fatigue, and metabolic disorders. Conventional treatments often involve hormone replacement therapy (HRT) and synthetic medications, which may have adverse side effects.

As a result, there is a growing interest in natural and holistic approaches to managing hormonal imbalances, including the use of functional foods enriched with bioactive compounds.

Herbal chocolate, a novel functional food, presents a promising alternative for addressing hormonal imbalances by integrating medicinal herbs with the well-known benefits of cocoa. Cocoa, the primary ingredient in chocolate, contains flavonoids, polyphenols, and magnesium, which have been associated with mood regulation, stress reduction, and improved endocrine function. When combined with specific medicinal herbs known for their hormone-balancing properties—such as ashwagandha, cinnamon—herbal chocolate can serve as a therapeutic and enjoyable intervention.

This study aims to formulate and evaluate herbal chocolate enriched with hormone-regulating herbs to assess its potential health benefits. By analyzing its phytochemical composition, sensory properties, and physiological effects, the research seeks to validate the efficacy of herbal chocolate as a functional food for hormonal balance. Additionally, consumer acceptance and nutritional profiling will be examined to determine the feasibility of incorporating herbal chocolate into daily diets as a natural remedy for hormonal disorders.

1.4 IDEAL PROPERTIES OF CHOCOLATE:-

For herbal chocolate formulated to treat hormonal imbalance, the ideal properties should encompass sensory, nutritional, and therapeutic aspects. Here are key properties:

1. Sensory Properties: -

- ❖ Smooth Texture – Should be creamy and melt easily in the mouth.
- ❖ Rich Aroma – A pleasant chocolatey scent with minimal herbal aftertaste.
- ❖ Balanced Taste – Should mask or complement the bitterness of herbal ingredients while maintaining a pleasant cocoa flavor.

2. Nutritional Properties: -

- ❖ Rich in Antioxidants – Cocoa and herbal extracts should contribute to high antioxidant content.
- ❖ Low Glycemic Index – Preferably made with natural sweeteners like coconut sugar or stevia to avoid blood sugar spikes.
- ❖ High Fiber Content – Helps with digestion and overall gut health, which impacts hormone balance.

- ❖ Healthy Fats – Should include cocoa butter and possibly other healthy fats (e.g., coconut oil) to support hormone production.

3. Therapeutic Properties: -

- ❖ Adaptogenic Benefits – Should contain herbs like maca, ashwagandha, or shatavari that support hormonal balance.
- ❖ Anti-inflammatory Effects – Ingredients should help reduce inflammation, which affects hormone regulation.
- ❖ Regulation of Hormonal Cycles – Herbs included should target specific hormonal pathways (e.g., phytoestrogens for estrogen balance).

4. Functional Properties:-

- ❖ Good Stability – Should have a stable shelf life and not degrade easily under storage conditions.
- ❖ Controlled Release of Bioactive Compounds – Should allow gradual absorption of herbal components for sustained benefits.
- ❖ Minimal Processing – To retain the nutritional and therapeutic properties of both cocoa and herbal additives.

1.5 APPLICATION OF HERBAL CHOCOLATE:-

1. Women's Health & Hormonal Balance: -

- o Menstrual Health – Supports relief from PMS symptoms like cramps, mood swings, and bloating (e.g., chocolate infused with chasteberry or ginger).
- o Menopause Support – Helps manage hot flashes, night sweats, and hormonal fluctuations (e.g., with black cohosh or maca root).
- o Fertility Enhancement – Contains herbs that support reproductive health, such as shatavari and ashwagandha.

2. Stress & Mood Regulation: -

- o Reduces Stress & Anxiety – Adaptogenic herbs like ashwagandha and Rhodiola help regulate cortisol levels and enhance mood.
- o Boosts Serotonin & Dopamine – Cocoa naturally increases serotonin, improving mood and reducing symptoms of depression.

3. Energy & Endurance Booster: -

- o Sustained Energy Release – Combines cocoa with energy-boosting herbs like maca or ginseng for improved stamina.
- o Hormonal Support for Athletes – Helps in balancing cortisol and testosterone levels for better performance and recovery.

4. Metabolic & Weight Management: -

- o Supports Metabolism – Herbs like green tea extract and cinnamon help regulate insulin sensitivity and fat metabolism.
- o Reduces Sugar Cravings – Natural sweeteners and adaptogenic herbs help curb sugar dependence and cravings.

5. General Health & Well-being: -

- o Immune Support – Rich in antioxidants and bioactive compounds to strengthen the immune system.
- o Gut Health Improvement – Fiber-rich formulations (e.g., with prebiotics or probiotics) promote better digestion.
- o Anti-Inflammatory Benefits – Herbs like turmeric and ginger help reduce systemic inflammation.

6. Functional Food & Nutraceutical Industry: -

- o Dietary Supplement Alternative – A tasty and convenient way to consume therapeutic herbs without capsules or powders.
- o Health-Conscious Snacking – Can be marketed as a healthy indulgence for consumers looking for functional foods.

II. MATERIAL AND METHOD :-

2.1 Materials :-

The ingredients used in the formulation of the herbal chocolate include:

- o Cocoa Powder (Primary chocolate base)
- o Butter (Fat component for texture and mouthfeel)
- o Coconut sugar
- o Ashwagandha (*Withania somnifera*) (Herbal adaptogen for hormonal balance)
- o Cinnamon (*Cinnamomum verum*) (Flavor enhancer and metabolic booster)
- o Tulsi (*Ocimum sanctum*) (Herbal adaptogen with anti-inflammatory properties)
- o Strawberry (as flavoring agent)

INGREDIENTS:-

1. Ashwagandha-

Botanical Name: *Withania somnifera*

Family:Solanaceae (Nightshade family)

Common Names: Indian Ginseng, Winter Cherry, Ashwagandha

Parts Used: Roots and leaves (Root is most commonly used in herbal medicine)

Active Compounds: Withanolides, Alkaloids, Saponins, Flavonoids

Traditional Uses:

- Adaptogen (helps the body manage stress)
- Supports hormonal balance (beneficial for PCOS and infertility)
- Boosts energy and stamina
- Improves sleep and reduces anxiety
- Enhances immune function
- Regulates blood sugar levels
- Acts as an adaptogen, helping the body cope with stress.
- Regulates cortisol levels, reducing adrenal fatigue.
- Supports thyroid health and may aid in balancing testosterone and estrogen.

Ashwagandha powder is a well-known Ayurvedic herb recognized for its powerful adaptogenic properties. Adaptogenic herbs help the body adapt to stress and maintain hormonal balance, making them beneficial for alleviating symptoms of hormonal disorders such as polycystic ovary syndrome (PCOS). Ashwagandha, in particular, supports the endocrine system by regulating the body's stress response, which plays a crucial role in hormone regulation.

By reducing cortisol levels, ashwagandha helps mitigate stress-related hormonal imbalances, which are often linked to PCOS symptoms. Its therapeutic effects include improving stamina, reducing fatigue, stabilizing blood sugar levels, easing anxiety, and alleviating mood swings. Incorporating ashwagandha into functional foods, such as herbal chocolate, offers a convenient and enjoyable way to harness its benefits while promoting overall hormonal health.

2. Cinnamon :-

Botanical Name: Cinnamomum verum (syn. Cinnamomum zeylanicum)

Family: Lauraceae

Cinnamon is a potent spice. It has been used for thousands of years not just for its aroma, but for its powerful medicinal properties as well. The most important properties of cinnamon are those of its antioxidants and type 2 diabetes. It can help manage this condition by reducing blood

pressure and improving insulin sensitivity. Certain compounds in cinnamon can imitate the effects of insulin and help regulate blood sugar, a function which is crucial for those with diabetes, Reduce cholesterol, Reduce inflammation low signs of aging hence We formulated the herbal chocolate nutritional supplement with three main herbs vitex used for hormonal imbalance, cinnamon used for sugar metabolism and tulsi used for stress and proper ovulation

3. Tulsi :-

Botanical Name: Ocimum sanctum (syn. Ocimum tenuiflorum)

Family: Lamiaceae.

Ocimum sanctum most popularly known as Tulsi has been used for thousands of years in Ayurveda for its diverse Healing Power, Kidney Stone, Basil has strengthening effect on the kidney. Stress: Basil leaves are regarded as anti-stress agents. Recent studies have shown that the leaves afford significant protection against stress it is also useful in headache , diabetes, stress. The herb contains detoxifying properties and antioxidants which rejuvenate the skin. It aids in removing toxins responsible for causing pimples, thus helping in the treatment of acne and leading to a reduction in the occurrence of breakouts. The herb leaves are effective in the treatment of oral infections. It is found to offer preventive properties to patients with periodontal disease as well.



4. Coconut sugar :-

Coconut sugar is a natural sweetener derived from the sap of coconut trees. It's a popular alternative to refined sugars.

Benefits of Coconut Sugar

1. Lower Glycemic Index: Coconut sugar has a lower glycemic index compared to white sugar, making it a better choice for those with blood sugar concerns.

2. Mineral-Rich: Coconut sugar contains minerals like iron, zinc, and potassium.
3. Less Processed: Coconut sugar is often less processed than white sugar, retaining more natural nutrients.

Using Coconut Sugar in Herbal Chocolate

Coconut sugar adds a rich, caramel-like flavor to herbal chocolate. Its lower glycemic index

and mineral content make it a popular choice for health-conscious chocolate makers.

Pairing Coconut Sugar with Herbs

Coconut sugar complements herbs like ashwagandha, tulsi, and cinnamon, enhancing their flavors and potential health benefits.

2.2 Methods:-

❖ Material Used In Formulation Of Herbal Chocolate :-

Sr. no	Name of Ingredients	Quantity
1.	Ashwagandha	3gm
2.	Cinnamon	500mg
3.	Ocimum Sactum	300mg
4.	Coconut Sugar	4gm
5.	Dark Chocolate	10gm
6.	Soya lecithin	0.05gm
7.	Butter	3gm
8.	Strawberry flavour	0.005mg

Table no. 1 Formula for preparation of herbal chocolate .

Preparation of Chocolate formulation.

1. All the ingredients were weight accurately.
2. In one beaker, cocoa powder and coconut sugar was taken and mixed properly.
3. In another beaker, butter has melted and this melted buyer was added in a powder mixture and mixed properly to get fine consistency.
4. After that soya lecithin as an emulsifier was added and mixed.
5. Finally the herbal drug powder /extract was measured accurately and added in above prepared chocolate .
6. Then strawberry as a flavoring agent was added before going to set in moulds.
7. Molding & Solidification :-
8. The tempered chocolate was poured into moulds and allowed to set at room temperature or refrigerated at 4-8 degree C for rapid solidification.
9. Total 7 formulations were prepared by varying the concentration of herbal drug extract used, while the concentration of excipients was kept constant. decorate with white milk powder.



Fig. No. 4 Formulated of herbal chocolate

Material And its Source :-

Material	Source
Ashwagandha	Local market
Cinnamon	Local market
Ocimum sactum	Local market
Coconut sugar	Local market
Dark chocolate	Local market
Butter	Local market
Soya lecithin	Charak Institute of pharmacy Laboratory, Mandleshwar

Table no. 2 Material and Sources used in formulation of herbal chocolate .

III. EVALUATION: -

1. Organoleptic (Sensory) Test:-

- o **Purpose:** Evaluates the overall acceptability of herbal chocolate based on human perception.
- o **Parameters:** Appearance, aroma, taste, texture, mouthfeel, and aftertaste.
- ✓ **Method:**
- o **Hedonic Scale** (9-point scale): Panelists rate sensory attributes.
- o **Descriptive Analysis:** Identifies herbal flavor intensity and any off-notes.

2. Stability Test:-

- o **Purpose:** Ensures the chocolate maintains quality, bioactive content, and microbial safety over time.
- o **Parameters:** Changes in taste, texture, color, and microbial growth.
- ✓ **Method:**
- o Store under room temperature (25°C), refrigeration (4°C), and high humidity (75-80%) for 3-6 months.
- o Monitor sensory, chemical, and microbiological changes.

3. Blooming Test:-

- o **Purpose:** Identifies fat and sugar bloom formation, which affects chocolate appearance and texture.
- o **Parameters:** Fat bloom (whitish layer due to cocoa butter migration) and sugar bloom.
- ✓ **Method:**
- o **Temperature Cycling:** Alternate storage at 30-35°C and 5-10°C to induce fat bloom.
- o **Humidity Test:** Store at high humidity (80%) to detect sugar bloom.
- o **Microscopic Analysis:** Examines bloom structure under a microscope.

4. Moisture Content Test:-

- o **Purpose:** Ensures the chocolate has a low moisture content to prevent microbial growth and texture degradation.
- ✓ **Method:**
- o Moisture Analyzer (Oven Drying/Karl Fischer Method) measures water content.

5. Texture Analysis Test:-

- o **Purpose:** Measures the firmness, hardness, and meltability of herbal chocolate.
- ✓ **Method:**
- o Texture Analyzer assesses hardness, brittleness, and breaking strength.

IV. RESULT & DISCUSSION:-

Discussion:-

The Formulated herbal chocolate aims to support hormonal balance using a combination of dark chocolate and medicinal herbs like Ashwagandha, Cinnamon. These ingredients help regulate cortisol, estrogen and other key hormones while providing antioxidant and essential nutrients.

Health Benefits of Herbal Chocolate: -

This combination offers a natural and enjoyable way to support hormonal balance. The chocolate enhances the bioavailability of the herbal compounds, making their effects more potent. Regular consumption may help with:

- ✓ Stress reduction and mood improvement
- ✓ Balanced cortisol levels for better adrenal health
- ✓ Improved insulin sensitivity, benefiting PCOS and metabolic health
- ✓ Hormonal support for menstrual health and menopause

By merging traditional herbal remedies with delicious dark chocolate, this formulation provides a therapeutic yet indulgent option for individuals seeking natural hormonal balance.

Result :-

Sr. no	Parameter	Observation
1	Colour	Brown
2	Oder	Chocolaty Fruity
3	Taste	Slightly Sweet
4	Mouth Feel	Smooth
5	Appearance	Glossy
6	pH	5
7	Hardness	Good

Table no. 3 Result of formulated herbal chocolate.

V. SUMMARY & CONCLUSION

The best formulation according to colour, odour, test and organoleptic properties this study was carried out to determine the physicochemical properties of chocolate based on colour, hardness, glossiness and fat bloom. The sensory evaluation of the chocolate was analysed at immediately after processing and at three months' storage.

Conclusion: -

It can be concluded that the provides Sweetening property as compare to others, pH& Stability profile to be satisfactory. Wide scope is Available for further in vivo study by using Cognition model or any suitable animal model. Herbal extracts of ashwagandha , cinnamon and tulsi were Successfully formulated in the chocolate Formulations and contain the active constituents i.e.β-carryophyllene, sabinene,andcinnamaldehyde, used for hormonal imbalance and sugar metabolism and also improve stress condition . The Organoleptic properties of chocolate are excellent for masking unpleasant flavors associated with some active agents and imparting a smooth and creamy texture to compositions of active agents. Thus chocolate formulation provides a palatable means for delivering medicaments through oral delivery. The drugs extracts, which are used in the dose Range are safe consumption and can be swallowed Without any risk o side effects.

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