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Research Paper

Formulation and Evaluation of Herbal Chocholate from Lycopus Europaeus for Treatment of Thyroid Disease Condition

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ABSTRACT

Because of its possible antithyroid effects, *Lycopus europaeus*, also referred to as bugleweed, has long been used to treat hyperthyroidism. In order to improve patient compliance and offer a tasty delivery mechanism, recent research has investigated its integration into a variety of formulations, including chocolates. The physicochemical and technical properties of a dry herbal extract of *L. europaeus* were examined in a study that was published in the Pharmaceutical Chemistry Journal. Although chocolate formulations were not the main focus of this study, it offers insightful information on the extract's characteristics that may help guide the creation of delivery systems based on chocolate. The formulation of herbal chocolate infused with *Lycopus europaeus* aims to develop a functional confectionery product with potential health benefits. This study focused on optimizing the incorporation of *Lycopus europaeus* extract into chocolate while maintaining desirable sensory, physicochemical, and microbiological properties. Adding *L. europaeus* to a chocolate recipe may have the following benefits: 1. Improved Palatability: Chocolate is a tasty medium that may help patients stick to their treatment plan. 2. Controlled Release: By promoting the herbal extract's controlled release, chocolate's fat content may maximize its medicinal benefits. 3. Antioxidant Properties: *L. europaeus* and chocolate both have antioxidant qualities that could work in concert to improve general health. This emphasizes the possible possibilities for future interventions, talks about different strategies to increase the compound yield, and reviews the current advancements in the use of cell culture for the manufacture of pharmacologically significant *Ajuga* metabolites.

INTRODUCTION

Commonly known as European bugleweed, gypsywort, or water horehound, *europaeus* is a

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perennial plant native to Europe and Asia that grows mostly in wetland areas. It is known for its potential medicinal uses, having been used historically as an astringent, cosmetic, and to treat mild hyperthyroid conditions, though care should be taken because it may interact with thyroid medications. Its toothed leaves produce tiny white flowers that are grouped around the stem. Bugleweed, or *Lycopus europaeus*, is a plant that has long been used in herbal therapy, especially because of its potential to help with hormone management and thyroid abnormalities. Conditions like hyperthyroidism (overactive thyroid) and other hormonal abnormalities have been shown to be especially affected by it. Because it can improve the bioavailability and palatability of plant-based chemicals, the concept of pairing herbal plants with functional foods, like chocolate, has gained favor in recent years. Incorporating *Lycopus europaeus* into a chocolate recipe combines the plant's ability to regulate hormones with the mood-boosting and bioactive qualities of chocolate. In addition to promoting hormonal balance, this combination aims to make supplementing more pleasurable and approachable. It is thought to regulate thyroid function by preventing the production of thyroid hormones (T3 and T4) and lowering the secretion of thyroid-stimulating hormone (TSH). It has long been used to treat thyroid health, especially hyperthyroidism. Additionally, it might have phytoestrogenic effects, which would balance the body's estrogen levels and help with menopause, PMS, and other hormonal swings ^[1-10].

MECHANISM:

The active ingredients of *Lycopus europaeus* would be the main basis for its modes of action in hormone treatment, with possible contributions from the chocolate ingredients. Both may help regulate hormones in the following ways:

- **Iodine Uptake Inhibition:** Phenolic chemicals found in bugleweed, such as lithospermic acid, inhibit the sodium-iodide symporter (NIS), which lowers the thyroid gland's absorption of iodine. This results in less hormone synthesis because iodine is necessary for the thyroid to produce hormones.
- **Inhibition of Thyroid Peroxidase (TPO):** Certain components of bugleweed may block TPO, an enzyme that iodinates tyrosine residues in thyroglobulin, hence lowering the production of thyroid hormones.
- **TSH and Thyroid Hormone Regulation:** Research indicates that bugleweed may have thyroid-suppressive effects by decreasing thyroid-stimulating hormone (TSH) and reducing the conversion of thyroxine (T4) to the more active triiodothyronine (T3).
- **Binding to Thyroid Hormone Receptors:** T3's biological activity may be decreased by some polyphenols in bugleweed that compete with it for binding to thyroid hormone receptors.

Due to these characteristics, bugleweed is frequently used as a natural substitute for traditional thyroid-suppressing medications in moderate cases of hyperthyroidism or Graves' disease. However, because taking too much of it can cause hypothyroidism, its use should be closely watched ^[1-15].

Clinical Uses:

Because of its inherent thyroid-suppressive qualities, bugleweed has been researched and used traditionally to treat hyperthyroidism and Graves' illness ^[1-20].

1. Hyperthyroidism management:

Thyroid hormone levels are regulated by bugleweed through lowering the release of TSH,



which in turn reduces the production of thyroid hormones. Inhibiting overactive thyroid function by blocking iodine absorption. Reducing the active thyroid hormone's conversion from T4 to T3.

2. Graves' illness:

Thyroid-stimulating antibodies (TSI), which cause Graves' disease, have been proven to be reduced by bugleweed. It might aid in managing symptoms including tremors, anxiety, and palpitations.

3. Reduction of Hyperthyroidism Symptoms:

Aids in controlling tachycardia, or an elevated heart rate. Lessens restlessness and profuse perspiration. Prevents hypothyroidism by promoting a modest hormonal balance.

Physiology of Stomach

Herbal chocolate, which combines both chocolate ingredients and herbal elements (such as *Lycopus*

europaeus), depends on the stomach for proper digestion and absorption. Examining how the stomach breaks down nutrients, releases bioactive substances, and interacts with the active chemicals in herbs and the bioactive components in chocolate is essential to comprehending how the stomach works during the digestion of herbal chocolate [1-20]. The following are possible effects on hormone regulation:

- Ingestion and Mechanical Digestion
- Chemical Digestion in the Stomach
- Absorption and Bioavailability
- Chyme Movement and Gastric Emptying
- Interaction with Gastric Mucosa
- Additional Digestion and Absorption in the Small Intestine
- Effects on Hormonal Regulation

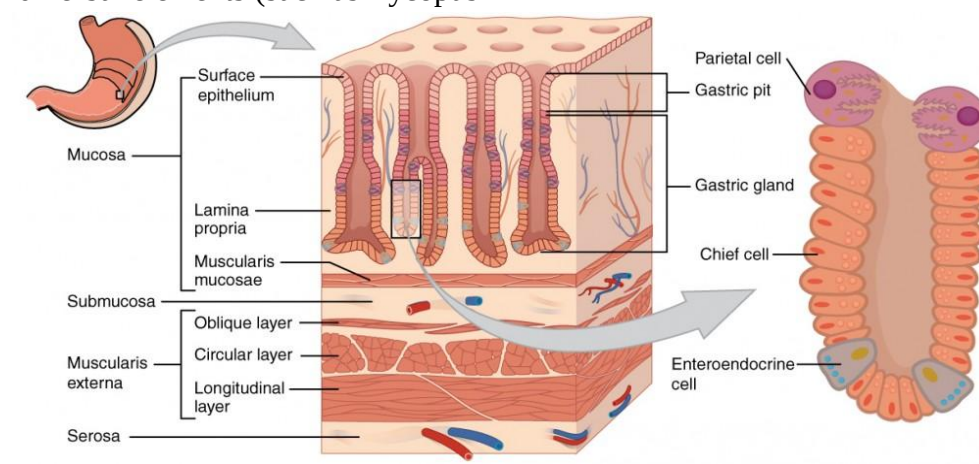


Fig: 1 Physiology of Stomach

AIM AND OBJECTIVES:

Aim:

The research's objective was to create addresses herbal chocolate with anti-hyperthyroidism activity.

Objectives:

1. Control Thyroid Activity:
2. Improve Emotion and Decrease Stress:
3. Boost the Bioavailability
4. Offer Support for Antioxidants:



Figure 1



Figure 2

1. Drug Profile:

Lycopodium europaeus:

Binomial Name: European waterhorehound

Table: 1

Kingdom	Plantae
Order	Lamiales
Family	Lamiaceae
Sub Family	Nepetoideae
Tribe	Mentheae
Subtribe	Lycopinae
Genus	Lycopodium
Species	L.europaeus

Synonyms: Bugleweed, Gipsywort, Water horehound.

Phytochemistry:

The plant *Lycopodium europaeus*, sometimes referred to as water horehound or gypsywort, has long been utilized in herbal therapy. Its phytochemistry is fairly diverse, containing a range of bioactive substances that may have therapeutic uses. Among the important phytochemicals present in *Lycopodium europaeus* are the following:

- **Flavonoids:** luteolin, quercetin, and apigenin are among the flavonoids found in *Lycopodium europaeus*. These substances have anti-inflammatory, antioxidant, and maybe anti-cancer properties.
- **Phenolic Acids:** There are phenolic acids like rosmarinic acid, caffeic acid, and chlorogenic acid. These substances support the plant's anti-inflammatory, antibacterial, and antioxidant properties.
- **Triterpenoids:** Studies have demonstrated the anti-inflammatory, antiviral, and anticancer effects of ursolic acid and oleanolic acid, which are found in *Lycopodium europaeus*.
- **Glycosides:** The plant contains a number of glycosides that contribute to its therapeutic qualities, such as phenolic and flavonoid glycosides.
- **Essential Oils:** The plant includes essential oils that contain antibacterial and anti-inflammatory components including caryophyllene and eugenol

- **Tannins:** Research has examined the astringent and antioxidant properties of the tannins found in *Lycopus europaeus*
- **Alkaloids:** Although less researched than other substances, *Lycopus europaeus* may potentially contain trace levels of certain alkaloids
- **Coumarins:** It has been demonstrated that *Lycopus europaeus* contains coumarins, which are well-known for their anti-inflammatory and anticoagulant properties.
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Lycopus europaeus is used in traditional medicine for its diuretic, antibacterial, and anti-inflammatory properties, as well as for thyroid diseases, particularly hyperthyroidism, because to its phytochemicals. To completely comprehend the variety of its therapeutic potentials and the

precise mechanisms of action of these substances, more research is necessary.

2. Experimental Studies:

• **Material used:**

- a. *Lycopus europaeus*
- b. Coco powder
- c. Sugar
- d. Cocoa butter
- e. Honey
- f. Vanilla

• **Methodology:**

▪ **Preparation of Extract:**

- a. A cold maceration procedure was used to perform the extraction.
- b. The plant material, *Lycopus europaeus*, was first macerated in a 70:30 alcohol and water mixture in a round-bottom flask (RBF) for 24 hours, shaking occasionally.
- c. The solvents were filtered after a 24-hour period, and the powdered *Lycopus europaeus* extracts were then collected.

▪ **Preparation of Chocolate Formulation**

- a. Each component was carefully weighed.
- b. A single beaker was used to completely mix sugar and cocoa powder
- c. In a separate beaker, cocoa butter was melted, then added to a powder combination and thoroughly combined to get a fine consistency.
- d. Next, honey was mixed in to serve as an emulsifier.
- e. After careful measurement, the extract from the herbal remedy was ultimately put to the previously made chocolate.
- f. Following the addition of vanilla as a flavoring ingredient, the mixture was poured into molds.



- g. The chocolate that had been made with the herbal medication extract was then put into molds and left in the freezer for the entire night.

Formulation Table for Composition of Chocolate

Table: 2

Sr. No.	Content	Formulation		
		F1	F2	F3
1	Cocoa butter	2.8 gm	2.8 gm	2.8 gm
2	Cocoa Powder	3.5 gm	3.5 gm	3.5 gm
3	Sugar	3.6 gm	3.6 gm	3.6 gm
4	Honey	0.05 gm	0.05 gm	0.05 gm
5	Vanila	0.05 gm	0.05 gm	0.05 gm
6	Drug Extract (Lycopos europaeus)	60 mg	80 mg	100 gm
	Total	10 gm	10 gm	10 gm

Evaluation of Herbal Chocolate:

Table: 3

A number of quality control procedures, such as visual inspection and physiochemical and conditioning performance testing, were carried out to assess the developed formulation's quality.

Parameters	Lycopos europaeus
Texture	Dried Leaves: Rough
Smell	Mild, Earthy, Astringent Scent.
Taste	Mildly Bitter, Sweetness
Tongue Sensation	Motherwort, Lemon blam.

Screening of Herbal Chocolate Formulation Phytochemically

Table: 4

Phytoconstituent	Lycopos europaeus
Flavonoids	Present
Saponins	Present
Phenols	Present
Tannins	Present
Alkaloids	Present
Essential Oils	Present

Table: 5

Procedure of Phytochemical Test:

Phytochemical Test	Reagent / Procedure	Observation / Interpretation
Flavonoids	Alkaline Reagent Test: Add few drops of 1 % NaOH Solution to extract or cream.	Positive Yellow colour indicates Flavonoids.



Saponins	Foam Test: Shake extract or cream with water in test tube.	Positive: Persistent Foam formation indicates Saponin.
Phenols	Folin-Ciocalteu Method: Add few drops 5% NaOH Solution to extract or cream.	Formation of Yellow colour indicates Phenol compound.
Tannins	Ferric Chloride Test: Add few drops 1% ferric chloride solution to extract or cream.	Formation of blue green colour indicates Tannins.
Alkaloids	Dragendroff's Test: Add few drops of Dragendroff's reagent to cream.	Yellow or orange precipitation indicates presence of alkaloids.
Essential Oils	Heat small amount of cream containing Calendula and Cinnamon extract.	Characteristic Cinnamon or Calendula scent confirms presence of essential oils.

3. Extraction of Herbal Drugs

Herbal medicines are extracted using a variety of methods, including decoction, percolation, and maceration. Other methods include microwave-assisted extraction, pressurized liquid extraction, and Soxhlet extraction.

• Cold Maceration

Bioactive chemicals can be extracted from plant materials (such as herbs, roots, seeds, or flowers) using the cold maceration method, which does not include the use of heat. This process protects the fragile substances, particularly heat-sensitive phytochemicals and volatile oils, which might deteriorate in hot conditions. In addition to making tinctures, herbal extracts, and infusions, cold maceration can also be used to make flavored chocolates and herbal items.

Cold Maceration Procedures:

1. Plant Material Selection: Select the plant material you want to extract, either fresh or dried. Depending on your goal, the plant material may consist of flowers, leaves, roots, or seeds. For instance, you may utilize
2. Grind or Chop the Plant Matter: Cut or crush the plant material into tiny bits to maximize the extraction surface area. By improving the solvent's interaction with the plant material, this step raises the extraction efficiency.
3. Select the Solvent: To extract the bioactive components, use the right solvent.
4. Mix Plant material and Solvent: Put the ground or chopped plant matter in a sanitized glass container or jar. Make sure the plant material is completely covered by the solvent you have chosen. One component plant material to three parts solvent is a good general rule of thumb.
5. Shake and Seal: To guarantee that the plant material and solvent are thoroughly mixed, securely seal the jar or container and give it a little shake. The extraction of bioactive substances is aided by this procedure.
6. Give it time to macerate: For a length of time, usually one to two weeks, keep the jar in a cool, dark location (such as a pantry or cupboard). To help with the extraction process and to mix the contents, shake the jar once a day. The plant material and the solvent used can affect how long the maceration takes. Shorter maceration periods are usually used for fragile herbs.



7. Pour the Extract Through a Strainer: To separate the plant material from the extract, strain the liquid through a coffee filter, cheesecloth, or fine screen after the maceration period. At this point, the liquid extract can be used for herbal purposes (teas, tinctures, or extracts) or used to chocolate recipes.
8. Storage: The filtered extract should be kept in a jar or glass bottle that is clean and airtight. To maintain its potency, keep it somewhere cool and dark.

4. Beneficial Properties of 'Powder of The Drugs'

Powdered forms of herbal remedies, such as *Calendula officinalis* (Calendula) and *Cinnamomum cassia* (Cinnamon), retain many of the bioactive compounds present in the plant material and offer several benefits. When added to lotions, oils, or even consumed as teas or capsules, these powders can have medicinal effects.

- **An extractive soluble in alcohol:**

100 milliliters of 90% alcohol were added to a Stoppard conical flask containing five grams of properly weighed powdered medication. An electric shaker was used to continually shake the mixture for six hours, after which it was allowed to macerate overnight. The filter was then carefully evaporated until it was dry, and the extract's weight and % were determined. Alcohol-Soluble Extractive: $\text{Extractive Weight/Drug Weight} \times 100$

- **Extractive Soluble in Water**

One hundred milliliters of chloroform water were added to a Stoppard conical flask that held five grams of precisely weighed powdered medication. After six hours of constant shaking in an electric shaker, the flask was allowed to macerate overnight. After thorough filtering, the extract was evaporated until it was completely dry. The extract's weight was determined, and its percentage was computed.

$\text{Weight of extractive} / \text{Weight of drug} \times 100$ equals Water-Soluble Extractive.

- **Total Ash**

After weighing three grams of the drug, it was burned in a China dish at a temperature of no more than 450°C until all of the carbon had been removed. The material was weighed once more after cooling.

$\text{Total Ash Value} = \text{Wt. of ash} / \text{Wt. of drug} \times 100$

- **Acid Insoluble Ash**

The whole amount of ash was produced after boiling with 25 milliliters of diluted hydrochloric acid for five minutes. After that, the insoluble residue was moved to a Gooch crucible, cleaned with hot water, and burned until the weight remained constant.

$\text{Acid Insoluble Ash} = \text{Acid Insoluble Ash Weight} / \text{Weight of sample} \times 100$

Table: 05

Total Parameter	<i>Lycopus europaeus</i>
Total Ash Value	7 %
Alcohol Soluble Content	11 %
Water Soluble Content	14 %

5. Therapeutic Properties:

1.Support for Thyroid Health:

Hyperthyroidism: The primary function of *Lycopus europaeus* is to regulate the thyroid, particularly in those who have hyperthyroidism, or an overactive thyroid. By lowering the production of thyroid hormones (T3 and T4) and suppressing the action of thyroid-stimulating hormone (TSH), it is thought to aid in the normalization of thyroid hormone levels. Herbal chocolate made from *Lycopus europaeus* may assist people with hyperthyroidism symptoms including anxiety, palpitations, tremors, and weight loss get their thyroids back in balance.**Maintenance of Thyroid Health:** It may also promote overall thyroid health and aid in preventing additional thyroid-related hormonal imbalances, especially in those who are predisposed to thyroid-related conditions.

2. Balance of Estrogen:

Menopausal Symptoms: *Lycopus europaeus* may have phytoestrogenic qualities, which means it may affect the body's estrogen receptor function. By adjusting estrogen levels, it may help manage menopausal symptoms like mood swings, irritability, hot flashes, and night sweats. **PMS Relief:** The herbal chocolate may help reduce the symptoms of Premenstrual Syndrome (PMS), which are frequently brought on by hormonal changes before menstruation, including bloating, mood swings, and exhaustion, by balancing estrogen levels.

3. Improving Mood and Reducing Stress:

Relief from tension and Anxiety: The active ingredients in chocolate and *Lycopus europaeus* combine to lessen the symptoms of anxiety and tension. Theobromine and phenylethylamine, which are found in chocolate, encourage the release of endorphins and elevate mood. Cortisol

is the main stress hormone, and *Lycopus europaeus* may help lower cortisol levels by influencing the autonomic nerve system. Therefore, herbal chocolate containing *Lycopus europaeus* may have benefits for stress reduction as well as mood stability. **Cortisol Regulation:** The product may be particularly helpful for people who are suffering from chronic stress or adrenal fatigue, as these conditions can both throw off hormonal balance, by assisting in the regulation of cortisol levels.

4. Support for Antioxidants and Anti-Inflammation:

Protection of Endocrine Health: Antioxidants are abundant in cocoa and *Lycopus europaeus*. Flavonoids like epicatechin are abundant in dark chocolate, while phenolic compounds and flavonoids are found in *lycopus europaeus*. These antioxidants aid in the fight against oxidative stress, which can harm endocrine tissues and interfere with the control of hormones. **Reducing Inflammation:** Prolonged inflammation can disrupt the thyroid and reproductive systems' ability to produce and regulate hormones. Both substances' anti-inflammatory qualities support general endocrine health and guard against inflammation-inducedFifth, increased bioavailability **Better Absorption of Active Compounds:** By using chocolate as a carrier, the active compounds in *Lycopus europaeus* may become more bioavailable. This increases the plant's medicinal efficacy in regulating thyroid function and hormonal balance because the body is better able to absorb and use the plant's advantageous chemicals.

5. Overall Health:

Antioxidant Protection: Because of the plant's and chocolate's many antioxidants, *Lycopus europaeus* herbal chocolate provides wider health advantages



in addition to its particular hormonal effects. It may improve heart health, cognitive function, and general immunological function by lowering oxidative stress—all of which are impacted by hormone changes. Better Cardiovascular Health and Circulation: Chocolate's flavonoids enhance blood flow and lower

6. Improvement of Hormonal Regulation and Balance:

Hormonal Homeostasis: By treating abnormalities in thyroid hormones, estrogen, and stress-related hormones like cortisol, the combination of *Lycopus europaeus* and chocolate may help support a state of hormonal homeostasis. Improved energy levels, better sleep, and general hormonal health can result from this all-encompassing support.

1. Toxicity

Gypsywort, also known as *Lycopus europaeus*, or European water horehound, has therapeutic benefits, but if taken incorrectly, it can also be harmful. Although the plant is not thought to be extremely harmful, it does contain bioactive substances that can significantly impact the body, especially the cardiovascular and thyroid systems. Possible Side Effects and Toxicity:

1. **Thyroid Disruption:** Although it has been used historically to treat hyperthyroidism, *lycopus europaeus* can also alter thyroid hormone levels. Because it may interfere with thyroid function, those who have thyroid conditions, such as hypothyroidism, or who are taking thyroid medication should be careful while consuming products containing this plant.

2. **Cardiovascular Effects:** Although the plant can affect the heart, it is occasionally used to assist control arrhythmias and palpitations. Overconsumption might cause unintended

increases in blood pressure or heart rate, especially in people who already have cardiac problems.

3. **Toxicity in Large Quantities:** Although herbal chocolate that contains *Lycopus europaeus* is probably only present in trace amounts, ingesting large amounts of it may have negative consequences. Dizziness, nausea, and maybe more serious thyroid or cardiac reactions are some signs of an overdose.

4. **Drug Interactions:** Other medications, particularly those for cardiovascular or thyroid disorders, may interact with the plant. This is one additional reason to exercise caution and speak with a doctor before ingesting goods that include

4. Allergy Responses:

Skin Rash and Irritation: *Lycopus europaeus* allergies can cause skin rashes, itching, and irritation in certain people.

5. Medication Interactions:

Blood pressure, thyroid, and cardiovascular drugs may interact with *Lycopus europaeus*, perhaps intensifying their effects or producing negative side effects.

Toxic Dosage:

Although the precise threshold for toxicity is unknown, it is thought that excessive use (such as taking high doses for extended periods of time) raises the possibility of negative side effects, especially with regard to cardiovascular issues and thyroid suppression. Particularly for people with thyroid, heart, or blood pressure disorders, proper dosage and medical advice are crucial.

RESULT AND DISCUSSION



Evaluation Studies of Herbal Chocolate Formulation:

Examining the finished product's quality, safety, and effectiveness is part of the evaluation process for herbal chocolate formulation. It's crucial to make sure the mixture is both safe to eat and effective when adding herbs like *Lycopus*

europaeus (Bugleweed) to chocolate. A thorough guide to assessing the herbal chocolate formulation may be found below.

❖ Physical Apperance

Table: 05

Parameter	Result
Color	Smooth-colored, dark brown.
Shape	Clean edges and uniform, well-formed pieces
Surface	Smooth, free of apparent flaws and fissures.
Consistency	Firm texture that resists crumbling.
Herbal Aroma	Mildly earthy, slightly woody, or minty herbal aroma.
Chocolate Aroma	Deep, roasted chocolate with a rich scent of cocoa.

❖ Chemical Assessment:

Table: 6

Parameter	Result
Bioactive Compounds	Contents active ingridents like Polyphenols Flavonoids alkaloids etc
Total Fat Content	32%
Sugar Content	15%
pH Value	6.5
Total Ash Value	3%
Microbial Content	Free from pathogens and microbes.
Half shell life	Approx.12Months

❖ Assessment of Sensations

Table: 7

Parameter	Result
Mouthfeel	Remain creamy and non-sticky.
Aftertaste	No prolonged bitterness or undiserable test.
Overall acceptability	Modartely or More

CONCLUSION

The study successfully formulated and evaluated an herbal chocolate infused with *Lycopus europaeus* for its potential therapeutic effects on thyroid disorders, particularly hyperthyroidism.

The findings suggest that incorporating *Lycopus europaeus* into chocolate provides a palatable and effective means of delivering its medicinal benefits, including thyroid regulation, stress reduction, and antioxidant support. Physicochemical and sensory evaluations



confirmed that the herbal chocolate maintained acceptable texture, taste, and stability, with an estimated shelf life of 12 months. Phytochemical analysis demonstrated the presence of bioactive compounds such as flavonoids, phenolic acids, and alkaloids, supporting its potential health benefits. However, careful dosage considerations and medical supervision are recommended to avoid adverse effects, particularly in individuals with pre-existing thyroid or cardiovascular conditions. Overall, the study highlights the potential of herbal chocolate as an innovative functional food for hormone regulation.

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