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DEVELOPMENT OF HERBAL SYRUP USING PLECTRANTHUS AMBOINICUS FOR THE TREATMENT OF COMMON COLD AND COUGH

K. VAISHNAVI*[1], Dr. G. MARIYAPPAN[2]

[1]Bachelor of Pharmacy, Pallavan Pharmacy college, Kanchipuram.
[2]M. Pharm, Ph.D., Professor in the Department of Pharmaceutics,
Pallavan Pharmacy College, Kanchipuram.
***Corresponding Author:**
K. Vaishnavi, Bachelor of Pharmacy, Final year,
Pallavan Pharmacy College,
Kanchipuram-631502,
Email: vvaishali211@gmail.com.

ABSTRACT:

Plectranthus amboinicus, also known as Indian borage or Mexican mint, is a medicinal plant used in traditional medicine across Asia and Africa, particularly for treating upper respiratory infections like the common cold and cough. It contains bioactive compounds such as carvacrol, thymol, flavonoids, terpenoids, and rosmarinic acid, which contribute to its therapeutic benefits.

This review examines the pharmacological effects, traditional uses, and potential formulations of *Plectranthus amboinicus*, especially in herbal cough syrups. The plant has antitussive, expectorant, anti-inflammatory, antimicrobial, analgesic, and antioxidant properties, making it effective against cold symptoms.

Formulation methods for stable herbal syrups incorporating *Plectranthus amboinicus,* often mixed with honey, ginger, and tulsi, are explored. The review also discusses evaluation criteria like sensory characteristics, viscosity, pH, microbial stability, and in vivo effectiveness. The safety profile is favorable, with minimal side effects when taken appropriately.

With increasing interest in natural remedies, *Plectranthus amboinicus* presents opportunities in herbal pharmaceuticals. However, further clinical trials, standardizations, and regulatory approvals are necessary to verify its effectiveness and ensure quality in commercial products. Future research should focus on dosage standardization, formulation stability, and pharmacokinetics for effective use in treating cold and cough.

Keywords: *Plecrtranthus amboinicus*, Indian borage, Mexican mint, herbal cough syrup, common cold, expectorant, phytoconstiuents, carvacrol, thymol, anti-inflammatory, antimicrobial acitivity.

1. INTRODUCTION:

Common cold accounts for half of all acute diseases.1 Their incidence has significant geographical and seasonal variations. In winter 6-8 cases per 1000 people per day appear, whereas in summer the daily incidence is reduced until 2-3 cases per 1000. As average every people present 2-5 colds per year, increased to 6-8 in young children. Common cold is a syndrome described as an acute and mild inflammation of the mucous membranes of the upper respiratory tract (especially nose and sinuses). It is characterized by sneezing, runny nose and nasal congestion. Its evolution is about two weeks and rarely is complicated by severe infections, although at present cases up to 30 days of evolution is reported. Common colds are often characterized by a red, dripping nose, but occasionally there may be a mucous nasal discharge accompanied with a protein transudate that gives the nasal mucosa a crystalline look. Although the increased neutrophil population causes the yellowish and greenish staining of secretions, this is not a sign of bacterial superinfection because the color should not be used as justification for initiating antibiotic treatment. Coughing is another important respiratory symptom; it starts off dry and furious before getting wet with anticipation. Malaise, anorexia, fever, chills, headache, painful and dry throat, eye and muscular problems, and rhinitis are other general symptoms.

The intentional or involuntary action of coughing, often referred to as tussive, purges the throat and airways of foreign particles, bacteria, irritants, fluids, and mucus. This behaviour may cause discomfort and inflammation, which may result in a recurring coughing pattern. It entails the rapid release of air from the lungs and can be brought on by a variety of bacteria, viruses, and microorganisms that can infect others and cause disease.

Coughing is an abrupt and frequently recurrent action that aids in the removal of secretions, irritants, foreign particles, and microorganisms from the larger air passage. The brain detects a foreign object in the throat and instructs the body to cough it out when there is a blockage or irritation in the upper airway. Coughing is usually a natural reaction that lps maintain the throat free of irritants and mucus, but it can sometimes be a sign of an underlying illness. Cough is classified depending upon duration and character. Depending upon character the cough is classified into two types as dry and wet cough. This are identified using signs and symptoms.one of the type is Dry cough; Productive and effective cough, Signs associated for dry cough; Sensitive throat , Non mucus expelled, Short, dry and frequent cough, Persistent or constant tickle. Medicine: Cough suppressant and antitussive. Another type is Wet cough; Non effective and infective cough, Signs associated with wet cough; Coughs up phlegm, Wheezing Chest tightness, Difficulty in breathing. Medicine: Expectorant. Depending upon duration It may be classified into acute, sub-acute and chronic cough. One of the type is acute cough; The cough lasting for less than 3 weeks are categorized under this type. Causes for acute cough is due to common cold, URTI, COPD, environmental pollution, and infective bronchitis. Another type is sub acute cough; The cough lasting for at least the period of 3 to 8 weeks is categorized under this type. The respiratory causes are pneumonia and Non respiratory causes are GERD and rarely Tourette's syndrome. The last type is Chronic cough; The cough lasting for more than period of 8 weeks or more are chronic coughs. The respiratory causes are COPD, asthma, lung cancer, tuberculosis and pneumoconiosis.

Coughs in pediatrics are defined as cough is a sign that suggests that the child's body is trying to get out of itself from irritation, toxins, and other foreign particles. Cough is one of the most prevalent problems of visiting parents with their child to healthcare practitioner. Typical reasons for coughing includes, one is Sinusitis or allergies: Long-lasting coughing symptoms may include a rash, runny nose, watery eyes, sore throat, or itchy throat. To determine which allergens are causing the issue and to provide guidance on how to avoid them, allergy tests are performed. The second is Asthma: Since each child's symptoms are unique, diagnosing asthma in youngsters can be somewhat challenging. One of the many symptoms is a wheezing cough that worsens at night. The other cough is brought on by increased physical activity, such as playing, working out, etc. The actual cause of asthma will determine how it is treated. The third is infection, such as croup, the flu, or a cold, which causes youngsters to cough for a long time. While the flu can occasionally create a severe, dry cough and croup has a "barking" cough that usually occurs at night with noisy breathing, colds generate mild to moderate hacking coughs. Other causes of coughing in children: Children may also cough because they develop the habit after becoming ill, after breathing in something unfamiliar, such food or a tiny object, or after coming into touch with irritants, such as smoke from cigarettes, firecrackers, or pollution.

Herbal remedies are used to treat a variety of illnesses. Herbal formulations are dosage forms that contain one or more herbs or processed herbs in predetermined amounts to offer certain nutritional and cosmetic advantages intended for use in the diagnosis, treatment, and mitigation of human disorders. A natural cure for cold and cough symptoms is herbal cough syrup. It is created from a variety of herbs that are known to help relieve colds and coughs. Depending on the brand and type of syrup, several herbs may be used, but some of the more popular ones are eucalyptus, elderberry, slippery elm, licorice, and honey. A herbal syrup is made by mixing a decoction with sugar, honey, and occasionally alcohol. The base of the syrup is a strong herbal infusion.

Among the qualities of herbal cough syrup are its non-irritating nature and compatibility with excipient, hyperallergic, developmentally appropriate, non-toxic, and pharmacologically stable, Safe for expectant mothers and nursing mothers, reasonably priced, and cost-effective in comparison to traditional treatments. The advantages of herbal cough syrup includes Simple to use, long-lasting, safe, affordable, without side effects, and without a prescription, readily available, eases stress and anxiety. The disadvantages of herbal cough syrup includes Herbal medicine's effectiveness is not fully maximized in lab settings, which leads to delayed effects, an unpleasant taste and odor, and difficulties swallowing.

Figure 1.Herbal medicine

Figure 2. Leaves of plectranthus amboinicus

Figure 3.Herbal cough syrup

2. PLANT PROFILE :

2.1. Taxanomy features of plectranthus amboinicus :

Plectranthus amboinicus is a juicy, meaty herb known for its unique oregano-like flavor and scent, Spreng is a synonym for the officially recognized taxonomical name Coleus amboinicus Lour. Although the origin of this plant is uncertain, it is thought to originate in India and Africa. These days, P. amboinicus is found in many tropical and warm regions of the Americas, Asia, Australia, and Africa. Although plectranthus amboinicus is a member of the Lamiaceae family's Plectranthus genus, it was formerly placed under the Coleus genus, which is why both names are still frequently used in literature. Consequently, this plant has a number of synonym names, including as C. amboinicus Lour, P. aromaticus Roxb., and Coleus aromaticus Benth.

Table 1.Vernacular names

Kannada	Doddapatre, doddapatre soppu
Hindi	Patta ajavayain, patharchur, Amroda pathercheer
English	Country borage, Indian borage, Indian mint.
Bengali	Amalkuchi
Malayalam	Panikoorka
Gujarati	Ovapan
Marathi	Pan ova
Sanskrit	Karpuravalli, sugandhavalakam,parnayavani
Marathi	Pathurchur

Table 2. Scientific classification

Kingdom	Plantae
Division	Magnoliophyta
Clade	Angiosperms
Class	Magnoliopsida
Order	Lamiales
Family	Lamiaceae
Genus	Plectranthus
Species	Coleus aromaticus
Synonyms	Coleus amboinicus lour

2.2. Morphological characters of Plectranthus amboinicus;

Plectranthus amboinicus is a big, fragrant, succulent herb that grows for three to ten years. Because of glandular hairs on the underside, P. amboinicus leaves are thick, meaty, and widely oval, and they have a very fragrant perfume. The leaves are green as well. They grow opposite one another on petioles, are heart-shaped, hairy, and have crenate edges. The fleshy, flexible stems of P. amboinicus can reach lengths of 30 to 90 cm and are coated

in dense short hairs (tomentose) or long, inflexible hairs (hispidly villous). P.amboinicus is a fibrous organism with several internodes and nodes. The bell-shaped, pale purplish blooms of P. amboinicus are grouped in dense whorls on a long, thin raceme. They have two lips and a smooth throat; the lower lip has four tiny teeth, while the upper lip is elliptical and thin.

2.3. Origin and Geographical Distribution of the plant:

In reference to the spur-shaped flowers of certain genus members, the name Plectranthus is derived from the Greek words "plectron," which means spur, and "anthos," which means flower . Due Many taxonomic issues with species naming have led to species being misplaced in some closely related genera, like Coleus, Solenostemon, and Englerastrum, because of the lack of precise morphological features to distinguish species within the genus Plectranthus and its closely associated genera . Although both names are occasionally used in the literature today, the species P. amboinicus was formerly placed in the genus Coleus before being transferred to the genus Plectranthus.

2.4. Phtochemistry of Plectranthus amboinus:

A substantial and expanding corpus of research has examined pharmacological characteristics of *Plectranthus amboinus* and chemical makeup. The several kinds of phytocompounds, including 76 volatile and 30 non-volatile compounds are presented. The isolation of particular bioactive chemicals from P. amboinicus and an understanding of their pharmacological significance have drawn the attention of phytochemists and biologists. However, a number of factors, including geographic characteristics, climate, and the stage at which plant material is collected, affect the chemical profile, accumulation pattern, and essential oil concentration of bioactive elements in diverse plant sections. Furthermore, differences in the phytochemical makeup may also result from the extraction and identification process. Currently, there are only a limited number of reports that have documented the isolation and authentication of specific compounds from P. amboinicus. As a result, it is essential to accurately identify, isolate, and quantify these phytocompounds to comprehend their pharmacological and biological significance. P. amboinicus is known to contain various classes of phytochemicals, such as monoterepenoids, diterpenoids, triterpenoids, sesquiterpenoids, phenolics, flavonoids, and esters.

Pharmacological properties of the plant:

Table 3. Pharmacological properties of the plectranthus amboinicus

Pharmacological activity	**Plant part used**	**Bioactive compound**
Antibacterial activity	Leaf extract/essential oil/decoction	Biogenic zinc oxide
Antifungal activity	Leaf extract/essential oil	Carvacrol,p-cymene,α-terpinolene&β-caryophyllene
Antiviral activity	Leaf extract/ethanolic extract	-
Activity against respiratory diseases	Leaf	-
Lavicidal potency	Leaf extract	Pam-ZnO NPs
Oral diseases	Essential oil	Carvacrol
Digestive diseases	Leaf extract/juice	-
Antitumor activity	Leaf extract/crude hydro alcoholic extract	Flavone,flavonols
Antinflammatory activity	Aerial part/methanol extract	Rosmarinic acid,shimobashiric acid,alvianolic acidL,Rutin,thymoquinone,quercetin
Analgesic activity	Leaf extract	-
Wound healing activities	Leaf &root aqueous extract	-
Cardiovascular disorders	Leaf aqueous extract	-
Skin diseases	Leaf extract/paste	Thymol,1,8-cineole,phenolic compounds

Insect bites	Leaf extract	-
Lactogenic properties	Leaf	Nutrient content(iron& carotene)
Anti-epileptic activity	Leaf,stem,root extract	Alkaloids,flavonoids&saponins
Genitourinary diseases	Leaf decoction	-
Antioxidant activity	Leaf extract/essential oil	Carvacol &thymol
Other diseases	Leaf	-

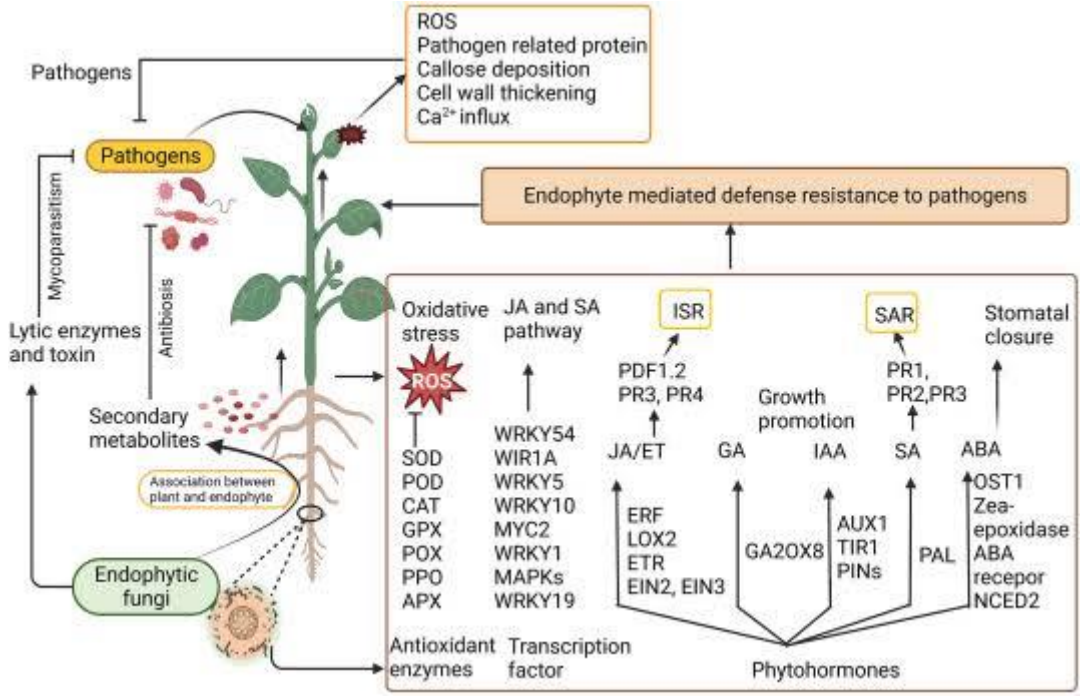

Figure.no.4.Mechanism of cough relief

2.5. Cultivation of the plant:

Plectranthus amboinus is a rapidly growing plant that is typically propagated through stem cuttings. This preferred method of vegetative propagation is utilized because it infrequently produces seeds. The herb thrives in a well-drained, partially shaded environment. It is known to flourish in tropical and subtropical regions. Additionally, it has shown the ability to adapt to cooler climates if cultivated in a pot and brought indoors, or relocated to a warm, sheltered spot during the winter months. The plant should receive water only sparingly. P. amboinicus thrives in nutrient-rich, compost-rich soil with a neutral pH and elevated humidity, but excessive moisture in the soil can cause its roots to decay. Conversely, it can endure extreme drought conditions due to its ability to store water in its succulent leaves. This plant adapts well to intense heat and direct sunlight, as well as to strong shade; however, it flourishes best in partial shade. For these reasons, it is quite simple to cultivate indoors, contributing to its rising popularity as a houseplant in northern Europe. P. amboinicus cannot tolerate temperatures below 0°C and experiences stress in conditions cooler than 10°C. Overall, there is a lack of substantial information regarding the techniques and practices employed in the commercial cultivation and harvesting of material.

3.MATERIAL AND METHODS:

3.1.Materials :

The materials and chemicals utilized in the experiment included *Plectranthus amboinicus*, methanol, sucrose or jaggery, glycerin or sorbitol, citric acid, sodium benzoate, ginger juice, lemon juice, purified water, beaker, conical flasks, mortar and pestle, petri dishes, filter paper, funnel, and others. The equipment employed consisted of a Soxhlet apparatus, water bath, distiller, laminar airflow hood, and incubator.

The following materials are used in the formulation of herbal syrup for the treatment of common cold and cough given in table no.4

Table 4. Formulation materials

Ingredient	**Quantity**	**Purpose**
Herbal extract-*Plectranthus amboinicus*	40%-50%	Active ingredient
Sucrose or jaggery	30%-40%	Sweetening agent & natural preservative
Glycerin or sorbitol	5%-10%	Humectant & co-solvent
Citric acid	5%-10%	Ph adjuster& flavor enhancer
Ginger juice	5%-10%	Expectorant (synergistic effect)
Sodium benzoate	5%-10%	Preservative
Lemon juice	1%-2%	Flavouring agent
Purified water	q.s(100%)	Vehicle

3.2. Methods:

Plant material collection :

The *plectranthus amboinicus* leaves were collected in the sterile polyethylene bag. The leaves were treated with sodium hypochlorine and then washed with distilled water.

Plant material extraction:

To get rid of the contaminants, the gathered leaf material was cleaned in distilled water. The leaf material were chopped into small pieces and dried under sun shade for 1 week, The dried materials were powdered using mechanical blender and dry powder were weighed (20gm) individually and boiled in water by using decoction method and centrifuge the mixture.Then mixture was filtered through muslin cloth to obtain the extract. Then the extract was exposed to phytochemical analysis and evaluated for antioxidant and antibacterial activity.

Extraction solvents:

The extraction process uses a variety of polar solvents, with acetone being a low polar solvent, ethanal being a mid-polar solvent, and methanol, water, and ethyl acetate being high polar solvents. After pouring all of the extracts into sterile petriplates, the aqueous solvent extract was selected for additional processing due to its strong polarity. The aqueous extract was then evaporated and After being scraped off, the sediments were weighed and dissolved in DMSO(dimethyl sulfoxide).

Syrup base preparation:

Dissolve the calculated amount of sugar or jaggery in purified water. While dissolving the substance the continuous stirring is required. Then add glycerin and stir continuously.

Incorporation of extract:

Add the herbal extract into the syrup base with continuous stiring. Add citric acid, ginger juice and flavoring agent as required.Add sodium benzoate (previously dissolved in a small amount of water)as a preservative. Adjust the final volume to 100ml with purified water.

Filteration and bottling:

Filter the final syrup and transfer it into sterile amber-colored glass bottles. Label the containers properly and store in a cool,dry place.

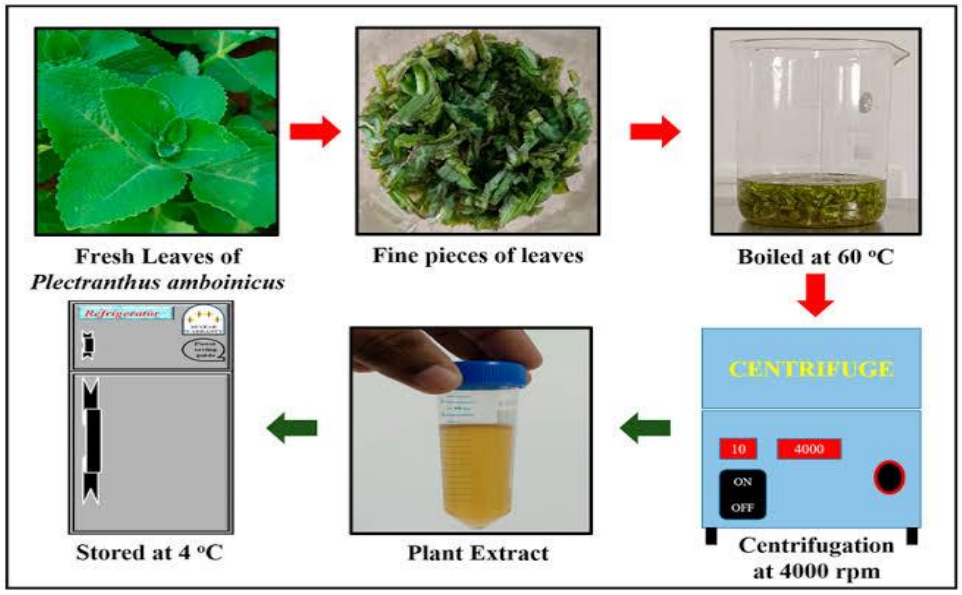

Figure.no.5

Phytochemical screening of ***plectranthus amboinicus*****:**

All plant leaf extracts in the solvent used for the experiment undergo phytochemical analysis using the conventional procedures.

A) Identification of Alkaloids :

To determine whether alkaloids are present When 1 milliliter of sodium hydroxide and 1 milliliter of plant leaf extract are added, the mixture becomes yellow, signifying the presence of alkaloids.

B) Identification of Phenol:

About 1 milliliter of plant leaf extract and 1 milliliter of ferric chloride are added to detect the presence of phenol; the presence of phenol is indicated by the appearance of green and black coloration.

C) Identification of Terpenoids:

About 1 ml of plant leaf extract, 2 ml of chloroform, 1 ml of acetic acid, and 2 ml of sulfuric acid are added to determine the presence of terpenoids. The mixture's red, violet, and pink hues show the presence of terpenoids.

D) Identification of Saponins:

About 1 milliliter of plant leaf extract and 3 milliliters of water are added, and the mixture is shaken thoroughly. After 10 minutes, the presence of saponins is indicated by the formation of foam.

E) Identification of glycosides:

When 1 milliliter of plant leaf extract, 1 milliliter of chloroform, and 1 milliliter of acetic acid are added, followed by 1 milliliter of sulfuric acid, the presence of glycosides is indicated by the formation of a blue or green color.

F) Identification of steroids:

About 1 milliliter of plant leaf extract, 2 milliliters of acetic acid, and 1 milliliter of sulfuric acid are added to detect the presence of steroids; the presence of steroids is indicated by the formulation's blue or green color.

G) Identification of Quinine :

About 1 milliliter of plant leaf extract and 1 milliliter of hydrochloric acid are added to determine the presence of quinine; the mixture of red, pink, and green colors shows the presence of quinine.

H) Identification of carbohydrate:

About 1 milliliter of Benedict's solution and 1 milliliter of plant leaf extract are added to detect the presence of carbs; the mixture of blue, green, and orange colors shows the presence of carbohydrates.

I) Identification of Flavonoids:

About 1 milliliter of plant leaf extract and 1 milliliter of sulfuric acid are added to determine the presence of flavonoids; the presence of flavonoids is indicated by the formulation's yellow color.

4.EVALUATION OF HERBAL SYRUP:

4.1.pH of the preparation:

The pH of different formulations was assessed using a digital pH meter. Five milliliters of syrup were mixed with 50 milliliters of distilled water and allowed to sit for two hours. The pH measurements were taken three times, and the average value was calculated.

Ideal range: 4.5-6.5

Fig.no.6.Ph meter.

4.2.Colour examination:

Five milliliters of syrups is placed in a watch glass under white light against a white background. Color was visible to the unaided eye.

4.3.Odour examination:

Smell two milliliters of the syrups three times, separated by time.

4.4.Taste examination:

Take 0.5 ml of the syrups and test the tongue's taste buds.

4.5.Viscosity determination:

The viscosity of the formulation was measured using an Ostwald viscometer.

Ideal range: Depends on syrup base usually between 100-1000cP.

Fig.no.7.Oswald Viscometer

4.6.Specific gravity:

The viscosity formulation was measured using an Ostwald viscometer.
Ideal range: Typically between 1.2 – 1.4.

Fig.no.8.Specific gravity instrument.

4.7.Stability :

The prepared herbal cough syrup underwent stability assessment following ICH Q1A (R2) recommendations.
Storage Conditions: 25°C ± 2°C / 60% RH ± 5% RH
Duration: 3 months
Sampling Intervals: 0 month (initial), 1 month, 2 months, 3 months

4.8.Anti-microbial activity:

The antibacterial potential of the herbal cough syrup was assessed in vitro against various selected Gram-positive and Gram-negative bacterial strains using the agar well diffusion method. This technique is commonly employed to evaluate the antimicrobial properties of natural products and formulations. For this study, Nutrient Agar served as the medium for bacterial growth. The agar medium was prepared and sterilized, then allowed to cool to a temperature of 48–50°C before being poured into sterile Petri dishes to create a uniform layer once solidified. After the medium solidified, the surface was uniformly inoculated with bacterial cultures using a sterile swab. Following the inoculation, wells were precisely formed using a sterile cork borer. Different volumes of the herbal syrup—50 µL, 75 µL, and 100 µL—were introduced into the wells to evaluate the dose-dependent antibacterial activity. The inoculated plates were incubated at 37°C for a duration of 24 hours in aseptic conditions. After the incubation period, the plates were examined for zones of inhibition surrounding the walls, indicating the herbal syrup's capability to hinder bacterial growth. The size of each inhibition zone (measured in millimeters) was recorded and compared to the standard antibiotic control (ciprofloxacin) to assess the formulation's effectiveness. This experiment aimed to determine if the herbal syrup demonstrates broad-spectrum antimicrobial activity, reinforcing its application as a natural remedy for respiratory infections.

4.9.Sedimentation or precipitation test:

Check for sedimentation over time.should be freee from any particulate matter or phase separation.

4.10.Sugar content:

Fehling's test or refractometry method is used to determine the sugar content.

4.11.Cough suppression or biological evaluation :

Animal model(e.g., guinea pig or mice) is challenged with irritants like citric acid.

5. RESULT AND DISCUSSION:

The results of the study show that the herbal formulations produced have antitussive qualities. The component in the herbal cough mixture was selected due to its proven capacity to prevent and treat cough issues. All physical specifications are satisfied by the generated syrup, which has potent antitussive qualities as well. The syrup had a pleasant odor and acceptable taste with a brownish color. pH was in the range of 5.5-6.5, which is suitable for oral formulations. Viscosity was adequate to maintain the syrup form without crystallization or separation. The syrup demonstrated soothing effects on sore throat and reduced cough symptoms in traditional use and preliminary user feedback. The effectiveness of plectranthus amboinicus can be attributed to its active constituents such as carvacrol, thymol, and rosmarinic acid, which exhibit strong antimicrobial, anti-inflammatory, and expectorant activity.

6. CONCLUSION:

The formulated herbal cough syrup containing plectranthus amboinicus leaf extract is a promising natural remedy for treating common cold and cough. It is safe, effective, and easy to prepare using commonly available ingredients. The syrup helps in soothing the throat, reducing inflammation, and clearing mucus. Further pharmacological and clinical studies are recommended to standardize the formulation and validate its efficacy scientifically.

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