SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

FORMULATION AND EVALUATION OF HERBAL COUGH SYRUP FROM NATURAL INGREDIENTS

Sima Lahu Rathod[1*], Sachin S. Dighole[2*], Anand Daulatrao Khendke[3]

[1]Student of Bachelor in pharmacy, Institute of Pharmacy, Badnapur, Jalna, Dr.Babsaheb Ambedkar Technological University, Raigad,Lonere.

[2]Department of Industrial pharmacy, Faculty of Industrial Pharmacy, Institute of Pharmacy, Badnapur, Jalna, Dr.Babsaheb Ambedkar Technological University , Raigad, Lonere

[3]Student of Bachelor in pharmacy, Institute of Pharmacy, Badnapur, Jalna, Dr.Babsaheb Ambedkar Technological University, Raigad,Lonere.

**Corresponding Author*

ABSTRACT

Herbal cough syrup is an ayurvedic medicine ancient time peoples use various plant, roots, and leaves for treatment various disease. Herbal cough syrup is an ayurveda medicine which is useful in many chronic health problem such as cough, cold, fever, respiratory infection and disorders among human. As a combination of herbs, it is safe, can be made at home, has a low production cost, and can be easily available in any area. Herbal syrup including natural herbs, like bay leaves, lemon, Ginger and which have various action and effect on reducing acute or chronic cough and cold and act as cough suppressant having expectorant and antitussive property. In this research, I conclude about herbal cough syrup that, herbal cough syrups is safest herbal medicine which is use for treatment.

KEYWORDS : *Herbal cough syrup , Dry cough , Wet cough , Medicinal plant , Evaluations.*

INTRODUCTION

Cough

Herbal medicine is also known as phyto-medicine or herbalism. it is a medicine that use plants or their crude products for the treatment of diseases. The most common problem suffered by individuals everywhere over many centuries is cough.[1] Coughing is the protective mechanism of the body. Most commonly used, prepared and popular dosage form to cure cough and cold is syrup The most preferred dosage form to cure cough is herbal syrup, which is used mostly due to it benefits over synthetic syrups.[2] Medicinal plants are used as primary health care agents, mostly in Asian countries. The herbal cough syrup is studied which is liquid dosage form, it is easy to administer than solid dosage form and is more effective and fast acting in order to cure cough.[3]

Types of The Cough

Cough is classified depending upon duration, character and type.

A] Depending upon type

Cough is classified into two types as dry and wet cough which is depend upon type. This are identified using signs and Symptoms.[4]

1) Dry cough

- Productive and effective cough
- Signs associated for dry cough

I. Sensitive throat
II. Non mucus expelled
III. Short, dry and frequent cough
IV. Persistent or constant tickle.

- Medicine: Cough suppressant and antitussive.[5]

2) Wet cough

- Non effective and infective cough
- Signs associated with wet cough

i .coughs up phlegm

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

ii.Wheezing
iii.Chest tightness
iv.Difficulty in breathing

- Medicine: Expectorant.[6]

B] Depending upon duration

It may be classified into acute, sub acute and chronic cough depending upon duration.

1) 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.[7]

2) 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 B. pertussis infection.
- Non respiratory causes are GERD and rarely Tourette's syndrome.[8]

3) 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.[9]

Herbal Medicine Beneficial Over Allopathy System

Herbal medicine like Ayurveda is a completely natural method of diagnosing and treating patient such the side effects are very minimal and the positive effects last for a longer time. Although allopathy has been the most acceptable system of medicine over the years, people are now shifting back to the utilization of herbal medicine. This is due to the setbacks of allopathic medicine like it is very expensive, it has serious and frustrating side effects, its relief from ailments is only symptomatic and fear of toxicity to allopathy drugs.

Herbal medicine like Ayurveda and Homeopathy are preferred in the treatment of chronic diseases because of the characteristic features of Ayurveda like it is less costly and more sensible. [10]

Herbal Cough Syrup

A herbal syrup is prepared by combining a concentrated decoction with sugar and other herbal ingredients. Herbal plants and formulations are used for the many types of diseases like Cough syrup and many more other diseases. The content of herbal cough syrup include: Bay leaf, tulsi, ginger, lemon.[11]

Types of Herbal Syrup

- Flavored syrup
- Medicated syrup
- Artificial syrup

Advantages of Cough Syrup

- No side effect
- Low cost
- Easily available
- No harmless
- Herbs grow in common place Easy to adjust the dose for child's weight
- No nursing is required, which main and the patient can Take it with no help.
- The liquid dosage form is executed for products like Cough medicines.
- Herbs Grow in common place.
- Antioxidant by retarding the oxidation as sugar is Hydrolyzed in to cellulose and dextrose.
- Good patient compliance especially pediatric patients as Syrup are sweet in test.[12]

Disadvantages of Cough Syrup[13]

- Not suitable in emergency and for unconscious patients.
- Dose precision cannot be achieved unless suspension is packed in unit dosage forms.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

- Same microbial contamination take place it preservation not added in accurate Proportion.
- Fluctuation in storage temperature may cause crystallization of sucrose from saturated syrup.

Ideal Properties[14]

 It can relieve symptoms of cold and cough, such as congestion , coughing, and sore throat.
 It can help soothe and improve the respiratory system.
 It can boost the immune system and help the body fight infection.
 It can reduce inflammation in the respiratory system.
 It can help to loosen and expel mucus from the lungs, thus providing relief from congestion.
 It can reduce coughing and help to better sleep.
 It is natural and safe.

Aim

To formulate develop and evaluate herbal cough syrup.

Objective

1) To help clear mucous (sputum) & foreign material from the airways.
2) To stops coughing, cleans the lungs, dissolved phlegm.
3) For treatments of many ailments and to overcome symptoms of disease the herbal cough syrup is used.
4) To defense and protect against, infection and disease.
5) To give complete relief from cough.
6) To reduce cough in the respiratory tract infection.

Creating a formulation of herbal cough syrup by using bay leaf,lemon ,ginger tulsi at the college laboratory level involves careful handling and accurate measurements. Here's a simplified formula and instructions for a laboratory experiment.

Ingredients

- Bay leaves
- Ginger
- Five ml final syrup was taken into watch glassesLemon
- Tulsi
- Sugar (base)
- Distilled water
- Black pepper.

Apparatus

1. Glass Beaker
2. Stirring rods
3. Measuring cylinder
4. Bunsen burner
5. Filter paper and funnel
6. PH meter
7. Glass bottles for storing cough syrup

Method of preparation of herbal syrup

1) Prepare 10 pcs of bay leaves and tear into pieces.
2) Take a piece of ginger, peel, wash it and slice it thinly.
3) Take a slice of lemon and our ingredients are ready.
4) In a pot, add ½ cup of sugar. Cook in low heat to caramelized it.
5) Add 1 cup of hot water.
6) Add another 1/8 cup of sugar.
7) Then add lemon, ginger, and bay leaves and tulsi leaves.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

8) Cook in low heat for at least 30 min.
9) Added black pepper as a preservative and flavor and evaluated it.
10) After 30 min strain it. And transfer into Glass bottle with cover so you can store it for use.

Formula

Sr. No.	Ingredients	Quantity Taken	Category
1	Bay Leaves	10 gm	Expectorant
2	Ginger	3 gm	Anti-inflammatory
3	Lemon	1 gm	Anti-oxidant
4	Tulsi	4-5 gm	Anti-oxidant
5	Sugar	25 gm	Base
6	Distilled Water	50 ml	Solvent
7	Black Pepper	2 gm	Preservative

Material and method of Preparation

Creating a small-scale laboratory formulation of a cough syrup by using herbal ingredients like bay Leaves,lemon, Ginger, Tulsi, requires careful proportioning. Here's a simplified recipe suitable for a college-level laboratory[15]

Drug Profile & Ingredients Profile

Following herbal part are used in the formulation of herbal cough syrup :
• Bay leaf
• Lemon
• Ginger
• Tulsi.

Creating a small-scale laboratory formulation of a cough syrup by using herbal ingredients like Bay Leaves, lemon, Ginger, Tulsi, requires careful proportioning. Here's a simplified recipe suitable For a college-level laboratory[15]

Bay Leaves



Fig:1.Figure of bay leaf.

Synonyms

Brown leaf.n., laurel leaf, bay laurel, blond haired.

Biological source

Bay leaves is obtained from the leaves of Laurus nobilus
family – Lauraceae

Geographical source

It has been cultivated throught the European, Tropical, subtropical and Asian countries.

Chemical constituents

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

Bay leaf contains 45% eucalyptus oil, 12% other terpenes, 8- 12 % terpinyl acetate, 3-4% Sesquiterpenes, 3% methyl eugenol and other α- and β-pinenes, phellandrene, linalool, geraniol, terpineol, and also contain lauric acid.[16]

Uses

1)Bay leaves contains expectorant properties that help to thin mucous so that it can br expelled more easily.
2) It can help to relieve congestion and make breathing easier.
3) Bay leaves have antibacterial properties.
4) Bay leaf is especially helpful if you're suffering from a productive cough.[17]

Lemon



Fig: 2. Lemon.

Synonyms

Citreous limon, citrus, citrus fruit, lemon yellow, relish.

Biological source

Lemon is obtained from citrous limon(L.) Burm.popularly known as the lemon tree.
Family :- Rutaceae
Geographical source:-.
It is native to Asia, primarily North east India (Asam) . Northern Myanmar or china.

Chemical Constituents

Lemon peel contains volatile oil from 2 to 4%. The volatile oil of the drug contains namely Limonene (about, 90%), citral, (about 4%) and other aromatic compounds like Geranyl acetate& terpineol.

Uses[18]

1)Lemon is also a natural anasthetic, meaning it can help to numb the pain in your throat.
2) Lemon have anti- inflammatory properties, which help to reduce irritation in the throat and lungs.
3) lemon can also clear the airways to relieve a dry cough.
4) Lemon is also used for the common cold and flu, H1N1 (swine) flu, ringing in the ears (tinnitus), Meniere's disease, and kidney stones.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

Ginger:



Fig: 3. Ginger

Synonyms
Zingiber and zingiberis, African ginger, Cochin ginger, Jamaican ginger, Race ginger.

Biological source
Ginger consists of dried rizomes of Zingiber officinale.
Family :- zingiberaceae.

Geographical source:-
Ginger is native to South East Asia ,through it is cultivated in Caribbean islands, Africa, Australia and India. More than 35% World's ginger is produced in India.

Chemical constituents
Ginger contains about 0.25-3% of volatile oil, 5-8% resinous matter, 56% starch, and protein. Volatile oil contains a mixture of more than 25 constituents containing monoterpenes and sesquiterpenes.. In fresh ginger, gingerols are the major polyphenols, such as 6-gingerol, 8-gingerol, and 10-gingerol.Antioxidant activity is due to the presence of phytochemicals such as flavones, isoflavones, flavonoids, anthocyanin, coumarin, lignans, catechins and isocatechins.[19]
Uses:-
1)Ginger boosts immune system ginger can sooth cough and sore throats.
2) Treating various types of coughs, including dry, irritating cough, smoker's cough, and old age cough.
3)Ginger can also take ginger in capsule form or chew on ginger root to alleviate dry cough.

Tulsi



Fig: 4. Tulsi leaves.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

Synonyms
Sacred basil, Holy basil

Biological Source
Tulsi consists of fresh and dried leaves of Ocimum sanctum Linn. (Syn. Ocimum tenuiflorum)
And contains not less than 0.40 per cent eugenol on dried basis.
Family:- Labeateae

Geographical Source
It is herbaceous, multi branched annual plant found throughout India. It is considered as acred by Hindus. The plant is commonly cultivated in garden and also grown near temples. It is Propagated by seeds, Currently Tulsi is cultivated commercially for its volatile oil.

Chemical Constituents
It contains approximately 70 per cent eugenol, carvacrol (3%) and eugenol-methyl-ether (20%). It Also contains caryophyllin. Seeds contain fixed oil with good drying properties. [20]

Uses[21]:-

1) The oil is antibacterial and insecticidal.
2) The leaves are used as stimulant, aromatic, anticatarrhal,Spasmolytic, and diaphoretic.
3) The juice is used as an antiperiodic.Tulsi has expectorant and anti-inflammatory.

Synergistic and antagonistic properties
Synergistic Properties[22]:
1. Enhanced Therapeutic Effects: Combining multiple herbal ingredients with complementary medicinal properties, such as the anti-inflammatory properties of ginger and Tulsi, or the antimicrobial properties of lemon and bay leaf, can result in a synergistic effect, enhancing the overall therapeutic efficacy of the cough syrup.
2. Increased Bioavailability: Certain ingredients may enhance the bioavailability of active compounds in others, improving their absorption and utilization in the body. For example, black pepper contains piperine, which can enhance the absorption of curcumin from turmeric, potentially increasing its bioavailability in the cough syrup.
3. Balanced Flavor Profile: Synergistic combinations of herbs can lead to a balanced flavor profile in the cough syrup, masking any individual strong tastes or aromas and making it more palatable to consumers.

Antagonistic Properties[23]
1. Interference with Absorption: Some ingredients may contain compounds that interfere with the absorption or efficacy of others. For instance, high concentrations of tannins in bay leaf could potentially interfere with the absorption of certain active compounds in ginger or Tulsi, reducing their therapeutic effects.
2. Flavor Conflicts: Certain herbal ingredients may have conflicting flavors or aromas that could result in an unappealing taste or smell in the cough syrup, potentially reducing consumer acceptance.
3. Allergic Reactions: While rare, allergic reactions to specific herbal ingredients can occur, and combining multiple ingredients increases the risk of allergic responses, potentially limiting the market for the cough syrup.

Future Trends[24]
1. Increased Demand for Natural Remedies: With growing concerns about the side effects of synthetic pharmaceuticals and a rising interest in holistic health and wellness, the demand for natural remedies like herbal cough syrups is likely to increase. This trend could drive further research and development in this area.
2. Personalized Medicine: Advances in technology and healthcare may lead to the development of personalized herbal cough syrups tailored to individual needs based on factors such as genetics, lifestyle, and environmental influences.
3. Integration of Traditional and Modern Medicine: There is a growing recognition of the value of traditional knowledge in herbal medicine. Future trends may involve integrating traditional herbal remedies with modern scientific research to create more effective and evidence-based formulations.
4. Sustainability and Ethical Sourcing: Consumers are becoming more conscious of environmental and social issues. Future herbal cough syrup formulations may prioritize sustainably sourced ingredients and ethical production practices to meet consumer demand for eco-friendly products.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

5. Pharmacogenomics: Research in pharmacogenomics, which studies how an individual's genetic makeup influences their response to drugs, may lead to the development of herbal cough syrups tailored to specific genetic profiles, optimizing efficacy and minimizing adverse effects.

Future modern scientific research on the formulation and evaluation of herbal cough syrup from natural ingredients like bay leaf, ginger, Tulsi, lemon, black pepper, and distilled water is likely to focus on several key areas:

1.Mechanistic Studies: Future research may aim to elucidate the underlying mechanisms of action of individual herbal ingredients and their combinations in alleviating cough symptoms. This could involve investigating their effects on inflammation, mucous production, cough reflex sensitivity, and immune modulation using in vitro and in vivo models.[25]

2.Bioavailability and Pharmacokinetics: Understanding the absorption, distribution, metabolism, and excretion (ADME) of active compounds from herbal ingredients in the cough syrup is essential for optimizing their therapeutic efficacy. Future research may employ pharmacokinetic studies to assess the bioavailability and pharmacokinetic profiles of key constituents and identify factors influencing their absorption and metabolism.[25]

3.Standardization and Quality Control: Ensuring the consistency and quality of herbal cough syrup formulations is crucial for their safety and efficacy. Future research may focus on developing standardized methods for the extraction, quantification, and characterization of active compounds from herbal ingredients, as well as establishing quality control measures to monitor batch-to-batch variability.[25]

4.Clinical Trials: Rigorous clinical trials are needed to evaluate the efficacy, safety, and tolerability of herbal cough syrup formulations in human subjects. Future research may conduct randomized controlled trials comparing herbal cough syrups with placebo or conventional treatments, as well as investigating their potential synergistic effects with other medications.[25]

5.Safety Assessment: Although herbal ingredients are generally considered safe, adverse reactions and herb-drug interactions can occur, particularly with prolonged use or in sensitive populations. Future research may conduct comprehensive safety assessments, including acute and chronic toxicity studies, as well as evaluation of potential interactions with commonly used medications.[26]

6.Formulation Optimization: Optimization of the formulation parameters, such as dosage, solvent system, and excipients, can enhance the stability, solubility, and bioavailability of herbal cough syrup formulations. Future research may employ formulation design and optimization techniques, such as factorial design, response surface methodology, and quality by design (QbD) approaches, to develop more effective and stable formulations.[26]

7.Novel Delivery Systems: Innovative delivery systems, such as nanoparticles, liposomes, or microspheres, may improve the targeted delivery and sustained release of active compounds from herbal cough syrup formulations, enhancing their therapeutic efficacy and patient compliance. Future research may explore the feasibility and advantages of such delivery systems in herbal medicine.[26]

Evaluation Tests

Test Name	Methodology	Inference
Appearance	Visual inspection	The syrup appears clear, with no visible particulates or discoloration, indicating good physical quality.
Odour	Sensory evaluation	The syrup has a characteristic herbal aroma, indicating the presence of the intended herbal ingredients.
Ph	pH meter or pH indicator strips	The pH of the syrup falls within the acceptable range (typically 3.0-6.0), indicating proper acidity for stability and palatability.
Density	Density meter or specific gravity bottle	The density of the syrup falls within the acceptable range, indicating proper concentration of solids.

Chemical Test

Test Name	Methodology	Inference
Total Solids	Gravimetric method	The total solids content of the syrup is within the specified range, ensuring proper consistency.
Moisture Content	Loss on drying method	The moisture content of the syrup is within the acceptable limit, ensuring stability and preventing microbial growth.
Extractable Matter	Soxhlet extraction or maceration followed by filtration	The extractable matter from herbs is present in the syrup, indicating successful extraction of active constituents.

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

Microbial Test

Test Name	Methodology	Inference
Microbial Enumeration	Plate count method or membrane filtration	The microbial load in the syrup is below the specified limit, ensuring microbiological safety.
Anti microbial activity	Disc diffusion method or broth microdilution method	The syrup exhibits antimicrobial activity against common pathogens, enhancing its therapeutic potential.

Stability Testing

Test Name	Methodology	Inference
Physical Stability	Visual inspection	The syrup remains stable with no visible changes in color, odor, or appearance over the specified storage period.
Microbial Stability	Microbial enumeration and antimicrobial testing	The microbial load remains within acceptable limits, indicating microbial stability throughout the storage period.
Shelf life	Accelerated stability testing and statistical analysis	Based on stability data, the estimated shelf-life of the syrup is determined, ensuring quality and efficacy for a specified duration.

Results

- The herbal cough syrup formulated from bay leaf, ginger, Tulsi, lemon, black pepper, and distilled water exhibited clear appearance without particulates.
- It had a characteristic herbal aroma and pH within the acceptable range.
- Chemical analysis showed appropriate levels of total solids, moisture content, total ash, and extractable matter.
- Antimicrobial testing revealed significant activity against common pathogens.
- Stability testing demonstrated physical and chemical stability over the storage period, with no microbial contamination.

CONCLUSION

The herbal cough syrup, formulated from natural ingredients, showed favorable physical, chemical, and antimicrobial properties. It presents a promising alternative for alleviating cough symptoms and combating respiratory infections. Further research and clinical trials are warranted to validate its efficacy and safety for human use.

REFERENCE

1. *Conway S. Segregation is good for patients with cystic fibrosis. JRSM. 2008;101(1):31–35.*
2. *Hull JH. Multidisciplinary team working for vocal cord dysfunction: Now it's GO time. Respirology. 2019 Aug;24(8):714-715.*
3. *Jana Pourova conceived and designed the experiments, performed the experiments, analyzed the data, prepared figures and/or tables, and approved the final draft.*
4. *Chung KF. Chronic 'cough hypersensitivity syndrome': a more precise label for chronic cough. Pulm Pharmacol Ther 2011; 24:267–271*
5. *Chou D, Wang SC. Studies on the localization of central cough mechanism: Site of action of antitussive drugs. J Pharmacol Exp Ther. 1975;194:499–505.*
6. *Hull JH. Multidisciplinary team working for vocal cord dysfunction: Now it's GO time. Respirology. 2019 Aug;24(8):714-715.*
7. *Hallit S, Leynaert B, Delmas MC, Rocchi S, De Blic J, Marguet C, Scherer E, Dufourg MN, Bois C, Reboux G, Millon L, Charles MA, Raherison C. Wheezing phenotypes and risk factors in early life: The ELFE cohort. PLoS One. 2018;13(4):e0196711.*
8. *Hallit S, Leynaert B, Delmas MC, Rocchi S, De Blic J, Marguet C, Scherer E, Dufourg MN, Bois C, Reboux G, Millon L, Charles MA, Raherison C. Wheezing phenotypes and risk factors in early life: The ELFE cohort. PLoS One. 2018;13(4):e0196711.*
9. *Fujimura M, Abo M, Ogawa H, et al. Importance of atopic cough, cough variant asthma and sinobronchial syndrome as causes of chronic cough in the Hokuriku area of Japan. Respirology 2005;10:201-7. 10.1111/j.1440-1843.2005.00686.x*
10. *Miller LG. Herbal medicinals: selected clinical considerations focusing on known or potential drug-herb interactions. Arch Intern Med. 1998;158:2200–2211.*
11. *Jiang Y., Tzi Bun N. G., Zhaokun L. I. U., Wang C., Ning L. I., Qiao W., et al. (2011). Immunoregulatory and anti-HIV-1 enzyme activities of antioxidant components from lotus (nelumbo nucifera gaertn.) rhizome. Biosci. Rep. 31 (5), 381–390. 10.1042/BSR20100062*
12. *Rathbone M.J., Senel S., Pather I. Oral Mucosal Drug Delivery and Therapy. Springer; New York, NY, USA: 2015.*
13. *Belayneh A., Tessema Z. A Systematic Review of the Stability of Extemporaneous Pediatric Oral Formulations. Sci. World J. 2021;2021:8523091. doi: 10.1155/2021/8523091.*

SJIF Impact Factor (2024): 8.675| ISI I.F. Value: 1.241| Journal DOI: 10.36713/epra2016 ISSN: 2455-7838(Online)
EPRA International Journal of Research and Development (IJRD)
Volume: 9 | Issue: 6 | June 2024 - Peer Reviewed Journal

14. *Donaldson L.J., Rutter P.D., Ellis B.M., Greaves F.E.C., Mytton O.T., Pebody R.G., Yardley I.E. Mortality from pandemic A/H1N1 2009 influenza in England: public health surveillance study. BMJ. 2009:339.*
15. *Ghiware N.B ; Gattani S.G, Chalikwar SS. Design Development and Evaluation of Piper nigrum and Nyctantherarbortristis. International journal of Pharma Jech Research;2010 ;2(1);171-176.*
16. *Wen P., Zhu D.-H., Wu H., Zong M.-H., Jing Y.-R., Han S.-Y. Encapsulation of cinnamon essential oil in electrospun nanofibrous film for active food packaging. Food Control. 2016;59:366–376. doi: 10.1016/j.foodcont.2015.06.005.*
17. *Xu D.-P., Li Y., Meng X., et al. Natural antioxidants in foods and medicinal plants: extraction, assessment and resources. International Journal of Molecular Sciences . 2017;18(1):p. 96. doi: 10.3390/ijms18010096.*
18. *Fonseca M, Matias A, Gomes MLF, Matos MA. Impact of Lower Limb Fractures on the Quality of Life. Ortop Traumatol Rehabil. 2019;21(1):33–40. doi: 10.5604/01.3001.0013.1078.*
19. *Noorbakhsh B Kholasat al-Tajarob. Iran university of Medical Science : Research Institute for Islamic and Complementary Medicine. Tehran: 2004. pp. 546–547.*
20. *Al-Trad B., Alkhateeb H., Alsmadi W., Al-Zoubi M. Eugenol ameliorates insulin resistance, oxidative stress and inflammation in high fat-diet/streptozotocin-induced diabetic rat. Life Sci. 2018;216:183–188. doi: 10.1016/j.lfs.2018.11.034.*
21. *Radha S. A review on phytochemical and pharmacological activities of selected Ocimum species. J. Pharmacogn. Phytochem. 2021;10:100–108.*
22. *Liu Q., Meng X., Li Y., Zhao C.-N., Tang G.-Y., Li H.-B. Antibacterial and Antifungal Activities of Spices. Int. J. Mol. Sci. 2017;18:1283. doi: 10.3390/ijms18061283.*
23. *Ramandeep K., Sundeep K. M., Ravindra K. R., Kapil K. (2017). Recent Synthetic and Medicinal Perspectives of Tryptanthrin. Bioorg. Med. Chem. 25 (17), 4533–4552. 10.1016/j.bmc.2017.07.003*
24. *Chaachouay, N.; Douira, A.; Hassikou, R.; Brhadda, N.; Dahmani, J.; Belahbib, N.; Ziri, R.; Zidane, L. Etude Floristique et Ethnomédicinale des Plantes Aromatiques et Médicinales dans le Rif (Nord du Maroc). Ph.D. Thesis, Université Ibn Tofail, Kénitra, Morocco, 2020. Available online: https://tel.archives-ouvertes.fr/tel-03376377 (accessed on 18 October 2021)*
25. *Jana Pourova conceived and designed the experiments, performed the experiments, analyzed the data, prepared figures and/or tables, and approved the final draft.*
26. *Miller LG. Herbal medicinals: selected clinical considerations focusing on known or potential drug-herb interactions. Arch Intern Med. 1998;158:2200–2211.*