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NATIONAL UNIVERSITY OF PHARMACY

Pharmaceutical faculty

Department of industrial technology of medicines and cosmetics

QUALIFICATION WORK

on the topic: «**DEVELOPMENT OF THE COMPOSITION OF TABLETS FOR THE TREATMENT OF THROAT INFLAMMATION BASED ON SAGE AND CHLORHEXIDINE»**

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ANNOTATION

This study aims to discuss several aspects of the development of tablet formulation for the treatment of sore throat using the combination of the herbal sage extract and the synthetic drug chlorhexidine as pharmaceutical ingredients. Lozenges (pastilles) are ideal for throat inflammation, they take advantage over orodispersible tablets (ODTs) because of their local action, faster action, prolonged onset and minimal side effects. In the double action lozenge, sage extract offers anti-inflammatory and antioxidant properties, while chlorhexidine provides broad-spectrum antimicrobial action.

The work consists of the following parts: introduction, literature review, research objectives, experimental part, general conclusions, list of used literature sources, total volume of 46 pages, contains 5 tables, 12 figures, 1 scheme, 30 references.

Key words: Sore throat, throat inflammation treatment, sage extract, chlorhexidine, echinacea, pharyngitis.

АНОТАЦІЯ

Це дослідження має на меті обговорити деякі аспекти розробки рецептури таблеток для лікування болю в горлі з використанням комбінації рослинного екстракту шавлії та синтетичного препарату хлоргексидину в якості фармацевтичних інгредієнтів. Льодяники (пастилки) ідеально підходять для лікування запалення горла, вони мають перевагу над ородисперсними таблетками (ОДТ) завдяки місцевій дії, кращій швидкості, тривалому початку дії та мінімальним побічним ефектам. У льодяниках подвійної дії екстракт шавлії має протизапальні та антиоксидантні властивості, а хлоргексидин забезпечує протимікробну дію широкого спектру.

Робота складається зі вступу, огляду літератури, завдань дослідження, експериментальної частини, загальних висновків, списку використаних літературних джерел, загальним обсягом 46 сторінок, містить 5 таблиць, 1 рисунок, 30 літературних джерел.

Ключові слова: Біль у горлі, лікування запалення горла, екстракт шавлії, хлоргексидин, ехінацея, фарингіт.

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LIST OF ABBREVIATIONS

AP- Acute Pharyngitis

API - active pharmaceutical ingredient

BAS – biologically active substance

CHG - Chlorhexidine Gluconate

CHX - Chlorhexidine

GMP - good manufacturing practice

CP - Chronic pharyngitis

FDA- Food and Drug Administration

GZA - Glycyrrhizic acid

ICI- Imperial Chemical Industries

IM – Infectious Mononucleosis

IVDs – In Vitro Diagnostics

NSAIDs – Non-steroidal anti-inflammatory drugs

ODTs - Orodispersible tablets

OTC – Over the Counter (drugs)

URT – Upper Respiratory Tract

WHO - World Health Organization

INTRODUCTION

The relevance of the topic:

Acute sore throat is one of the most commonly seen conditions in the medical field, rating as one of most common diseases affecting global communities, this disease encompasses any upper respiratory tract (URT) infection most often caused by viruses or bacteria, leaving pain in the throat as a predominant symptom. In most cases, accompanied by inflammation and swelling of the pharyngeal region, leading the patient in the search of relief either in the hands of doctors or in use of NSAIDs such as paracetamol, ibuprofen, diclofenac, and acetylsalicylic acid, or anesthetic substances such as lidocaine. In addition, substances such as chlorhexidine, with a broad antimicrobial activity, are in use. And to ease symptoms the patient usually can use herbal medicinal products. [4]

In North America and Europe, Echinacea purpurea has become a very popular phytomedicine and herbal supplements. Echinacea preparations are advertised and also used globally to give early treatment for colds and as immunostimulants and belong to the best-selling herbal medicines in the United states of America. The purple coneflower is a plant with an old tradition of being used as a remedy in the treatment of upper respiratory tract infections, and the latest researches confirmed the efficacy of echinacea preparations in the treatment and prophylaxis of these infections. Such a plant and with the anti-inflammatory properties, it has a big immune modulatory properties that are mediated by an endocannabinoid receptor. Moreover to this, antiviral and antibacterial properties have been reported.

Lozenges are oral solid preparations meant to be dissolved slowly inside the mouth or pharynx. They may include one or more medicines in a flavored and sweetened base and their goal is to treat local irritation or infection of mouth or pharynx and may also be useful for systemic drug absorption. Lozenges also are intended to achieve local effects such as easing and purging the throat. [15]

The purpose of the study:

Development of the composition of tablets for the treatment of sore throat based on sage extract and chlorhexidine.

Research tasks are

-To study technological parameters of the substances: Sage extract and Chlorhexidine

-To develop the composition and technology of 'Lozenges' with sage extract and chlorhexidine

-To investigate the technological parameters lozenges with sage extract and chlorhexidine.

The object of research:

Sage extract; Chlorhexidine; Lozenges

The subject of the study

The process of development of technology of lozenges.

Research methods:

Methods of technological research according to the methods of the State Pharmacopoeia of Ukraine were used.

Practical significance of the obtained results

The results of the study can be used in the development of fast-dissolving tablets at the pharmaceutical plants.

Elements of scientific research

The process of tableting of fast-dissolving tablets with nimesulide and additional substances were studied.

Structure and scope of qualification work

Qualification work consists of the following parts: introduction, literature review, choice of research methods, experimental part, general conclusions, list of used literature sources, total volume of 46 pages, contains 5 tables, 12 figures, 30 references

CHAPTER 1

CURRENT STATE OF THE TECHNOLOGY OF LOZENGES

1.1. Overview on the disease

One of the most acute upper respiratory tract infections is sore throat, which affect the respiratory Mucosa of the throat. While infections can affect any part of the mucosal tissue, it is often hard to determine whether an acute upper respiratory tract infection is a |sore throat 'sore throat' ('pharyngitis' or 'tonsillitis'), 'common cold', 'sinusitis', 'otitis media', or 'bronchitis' (figure 1.1.).

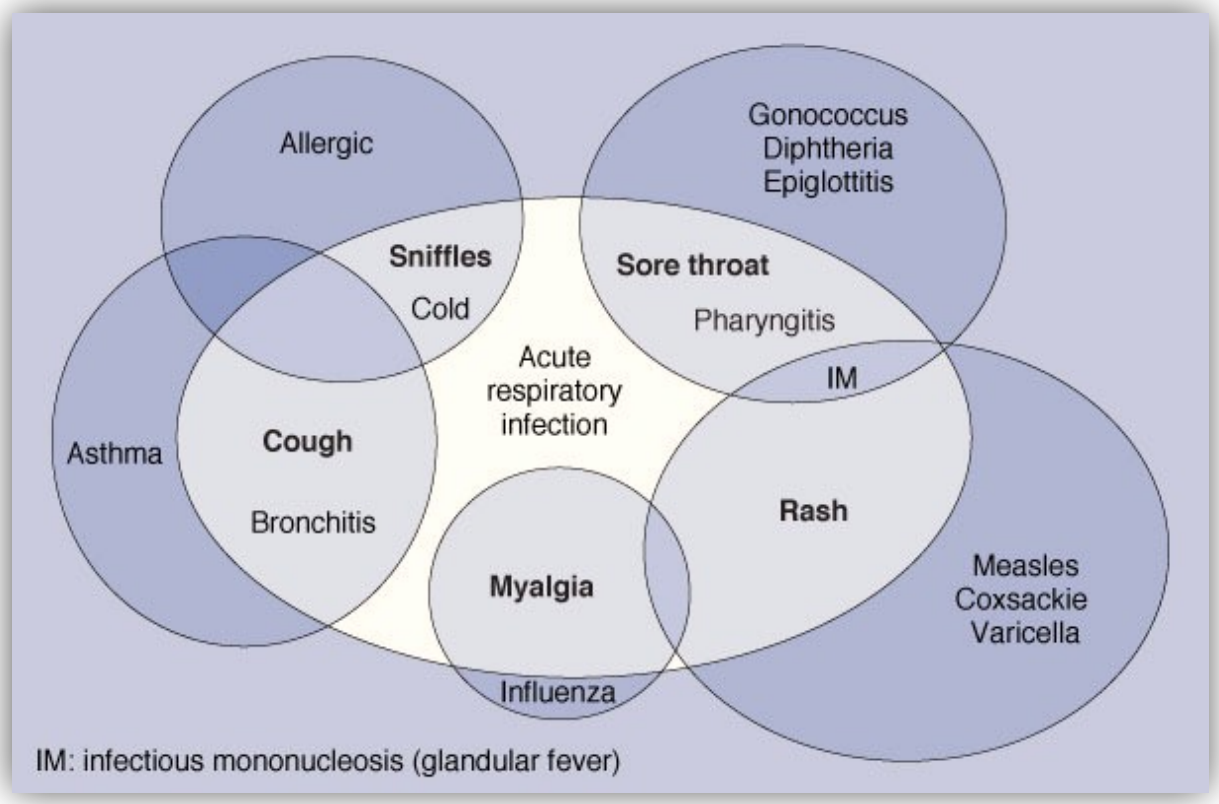


Figure 1.1. Acute respiratory infection

Pharyngitis is classified in two main classes. Healthcare workers categorize them based on how long symptoms last:

Acute pharyngitis (AP): it lasts from about 3 to 10 days. most cases are acute pharyngitis.

Chronic pharyngitis (CP): it lasts for more than ten days (usually several weeks) or that keeps returning after symptoms start decreasing.

One of the most common causes of sore throat is viruses leading to colds or flu, sore throat can also be caused by:

The bacteria group A Streptococcus, (also called streptococcal pharyngitis)

Allergies;

Smoking or exposure to secondhand smoke.

The following medicines are used to reduce pain and stop the Sore Throat infection.

Paracetamol help reduce the pain of acute infective sore throat after regular doses over 2 days. As a side effect of this drug we can note a rare but serious skin.

Non-steroidal anti-inflammatory drugs (NSAIDs) help reduce the pain of sore throat at 2 to 5 days' treatment, excess of use can lead to gastrointestinal and renal adverse effects.

Antibiotics may decrease the percentage of individuals experiencing sore throat symptoms after three days. Antibiotic has more effect on people with positive throat swabs for Streptococcus than for people with negative swabs. They can also cause side effects including nausea, rash, vaginitis, and headaches, and their extensive use might result in bacterial resistance.

Combining corticosteroids with antibiotics may help decrease the intensity of sore throat pain in people, as opposed to using antibiotics alone.

Verum and placebo lozenges were used in a treatment of 3 days, and they had a clinically appropriate analgesic result on sore throat, actually they achieved improvement in swallowing for adult patients with acute pharyngitis.

In Ukraine, a numerical diagnosis of tonsillitis (inflammation of tonsils), diphtheria (a bacterial infection), and glandular fever is significant for sore throat of infectious origin. Localization and nature of sore throat, color of plaque, and possibility to remove plaque are clinical signs that can also be used by a

pharmacist when referring a patient to a doctor (see Scheme 1.). The simplified progression of doctors' actions in the treatment of pharyngitis, which is recommended by worldwide (in particular European) guidelines, can be presented by the specified algorithm bellow:

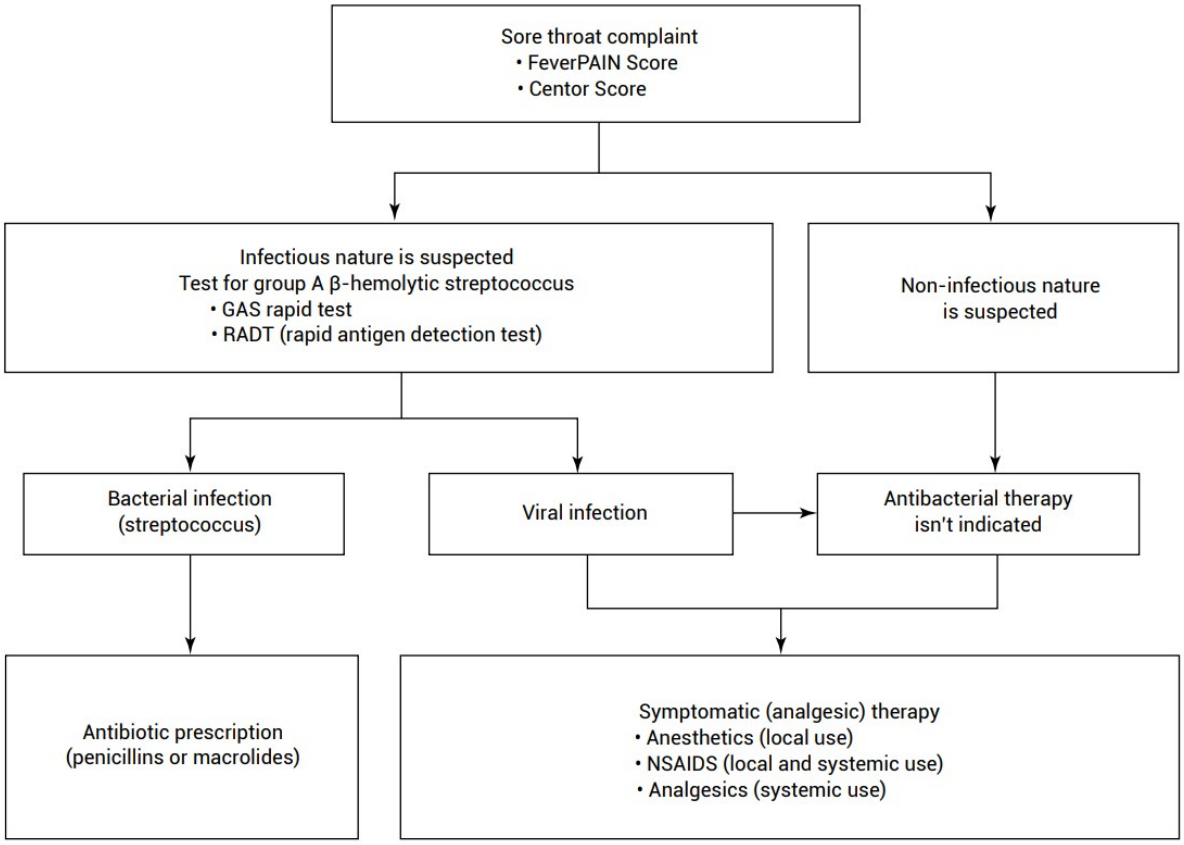


Figure 1.2. The basic algorithm of actions to be taken by a doctor in the diagnosis and treatment of tonsillitis (compiled on the basis of international guidelines). [3]

1.2. Role of sage extract in medicine

Throughout history, nature has been a significant source of therapeutic materials, granting us access to numerous medicinal plants that produce beneficial phytochemicals. The perennial herbaceous plant Echinacea purpurea, commonly called purple coneflower, is part of the Asteraceae family. The Echinacea genus originates from North America, specifically in the United States, and its various species are commonly found across the region. Although there are nine different

Echinacea species, only three are commonly utilized for their medicinal benefits across various treatments. Echinacea purpurea (L.) Moench, Echinacea pallida (Nutt.) Nutt. and Echinacea angustifolia DC. Various important groups of bioactive compounds with pharmacological properties have been extracted from Echinacea species. The most important beneficial effect of these bioactive compounds is the immunomodulatory effect. There have been multiple reviews that gives a comprehensive efficacy of the chemical constituents, bioactive compounds, biological effects and therapeutical uses of purple coneflower. [6]

Salvia officinalis extracts are used to relieve inflammation in the mouth. In addition to the anti-inflammatory and anesthetic properties, they also employ antimicrobial activity against different pathogenic pains, including *Staphylococcus aureus*, *C. albicans*, *S. typhi*, or *S. enteritidis.* [35]

"*Echinacea*/*Salvia* lozenges" are an extension of EF and sage extract-containing products specially aimed to patient convenience increasing. The combination of *Echinacea* and *Salvia* in the lozenge are equivalent to the content of "A. Vogel Sore Throat Spray," some clinical studies proved the effectiveness of chlorhexidine/lidocaine-containing comparator. These clinical studies aimed to dispose the safety and effects of the *Echinacea*/*Salvia* pastilles for the cure of early symptoms of acute sore throat, cold symptoms, and the virus charge in the oropharynx. [35]

Figure 1.3, shows the evolution over time of publications on the genus Echinacea and the species *Echinacea purpurea* (L.) Moench. scientific researches has been increased on these species over time until 2009, after which a slight reduction was noticeable until 2015, followed by an increase again up to now.

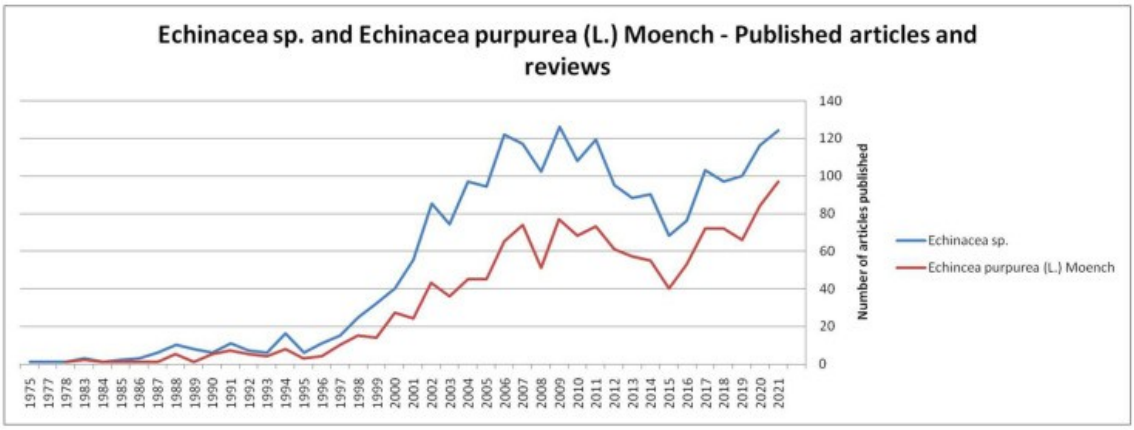


Figure 1.3. publications on the genus Echinacea and the species *Echinacea purpurea* (L.) Moench

Echinacea species contain various important groups of bioactive compounds, with pharmacological activities, they have been isolated from the plant. The most significant compositions of Echinacea purpurea (L.) Moench are alkylamides, polysaccharides, glycoproteins, flavonoids and phenolic compounds, that involve derivates of caffeic acid, including: chicoric acid, caftaric acid, chlorogenic acid and echinacoside, whose quantity differ based on the plant's divisions. Additionally, to these constituents, we identified more components like phylloxanthobilins, β-phellandrene, acetaldehyde, dimethyl sulfide, camphene, hexanal, α-pinene and limonene that are existing in total plant tissues, regardless of species. The presence of Fatty acids, aldehydes and terpenoids counts on the parts of plants used.

Glycoproteins, alkylamides and polysaccharides are the chemical elements responsible for the immunomodulatory activities of purple coneflower roots. Glycoproteins are chains of proteins and carbohydrates that have a task in a diversity of physiological actions, including immunopathology.

The bactericidal effects of Echinacea against a range of ordinary human pathogenic bacteria associated with respiratory infections were evaluated by a

group of researchers. The data showed abundant selectivity in anti-bacterial activities. *Streptococcus pyogenes*, *Hemophilus influenzae*, and *Legionella pneumophila*, at a dilution of 1:100 or less, they were very sensitive to Echinacea (the tests were run in the presence and absence).

In another study, the extracts of essential oil from E. purpurea were first reported that they have in vivo anti-inflammation effects caused by tumefaction, effusion and hyperplasia.

1.3 Chlorhexidine: Properties and Uses:

Chlorhexidine is an antibacterial, a cationic polybiguanide used as an antiseptic and for different applications. used primarily for its salts, Chlorhexidine has its own effects on various parts of the body. Commonly used as a disinfectant and an active component of mouthwashes as it acts longer in the oral cavity.

Chlorhexidine is still considered the go-to standard when it comes to fighting plaque and gingivitis. What makes it so effective is that it not only kills bacteria but also stops them from growing, and it sticks around in the mouth long enough to keep working. While other products might have one or two of these qualities, very few have all three, and that's what sets chlorhexidine apart. Its strong antimicrobial power comes from its di-cationic structure, but that same feature is also what causes one of its most common side effects: staining on the teeth. By understanding how chlorhexidine works on a chemical level, we can better appreciate its benefits and learn how to use it in a way that gets the most out of it while keeping side effects to a minimum. That's why it continues to be the top choice in dental care. [2]

Chlorhexidine is an antiseptic and disinfectant commonly used to reduce the number of bacteria in the mouth or on the skin. It is effective in treating conditions such as: Mouth infections, ulcers, and gum disease; Sore throats; Denture-related issues; Skin infections. Chlorhexidine is often combined with other ingredients. For example, some throat treatments include a local anesthetic to help relieve pain.

Products for the mouth and throat are available in various forms, including mouthwashes, lozenges, gels, and sprays.

1.4 Lozenges as a mode of administration

Many types of oral formulation exist, many providing benefits that other forms can't provide. They can be affordable, safe, natural and an easy route of drug administration. No medical assistance is needed, which means the patient can take it by himself. Their toxicity is delayed due to the onset of action which gives easier recovery compared to other dosage forms.

They can be suitable to any patient, no matter how old he can be. Oral dosage forms surely have disadvantages too. They're not the headmost choice of drugs if the patient suffers chronic vomiting. They're not good in case of unpredictable patients as children and infants, and not suitable in an emergency and for unconscious patients. Also, they're not convenient for someone with a gastrointestinal disorder such as diarrhea, constipation, ulceration, hyperacidity in stomach; and if a patient suffers malabsorption syndrome in which absorption through the small intestine is not ensured. Lozenges are also for systemic effect given the drug is well absorbed through the buccal linings or when it is swallowed, they're placed in the oral cavity. Lozenges are designed to be placed in the oral cavity. Since the sublingual lozenges may be impractical due to their size, buccal lozenges are developed and have been widely used and they're intended to be put between the cheek and the gums. [10]

Though the lozenge dissolution time is about half hour, this varies on each patient; as the patient controls the rate of dissolution and absorption by sucking on lozenge until it dissolves. The consequence of this can be high variabilities in amounts of medicine delivered each time the lozenge is administered. Sucking and the subsequent production of saliva may also lead to increased dilution of the drug and involuntary swallowing.

ongestants, while vitamins and nicotine are examples of systemic effects.

According to Texture and Composition: Advantages: It's simple to administer to both pediatric and geriatric patients. It is tasty and will extend the time an amount of drug remains in the oral cavity to elicit local activity. Systemic absorption of the medicine is possible through buccal cavity. It can be prepared in easy ways. The taste of the drugs can be concealed by sweeteners and flavors used in the formulation. [8]

Disadvantages: It could be seen easily as candy to children. Parents should be careful placing these medications with candy and to keep the product out of the reach of children. Some drugs may not be suitable with aldehyde candy bases eg; benzocaine. Heat stable drugs are suitable. Children over 6 years of age can use lozenges safely. Drugs having lower bitter taste are suitable. [8]

Drug candidates which can be incorporated in lozenges include antiseptics, local anesthetics, antibiotics, antihistamines, antitussives, analgesics, decongestants and demulcents.

Lozenges can be classified into different classifications based on various methods such as according to the site of action which can either be local and systemic effects. Examples of local effects are antiseptics, decongestants, while vitamins and nicotine are examples of systemic effects.

According to Texture and Composition:

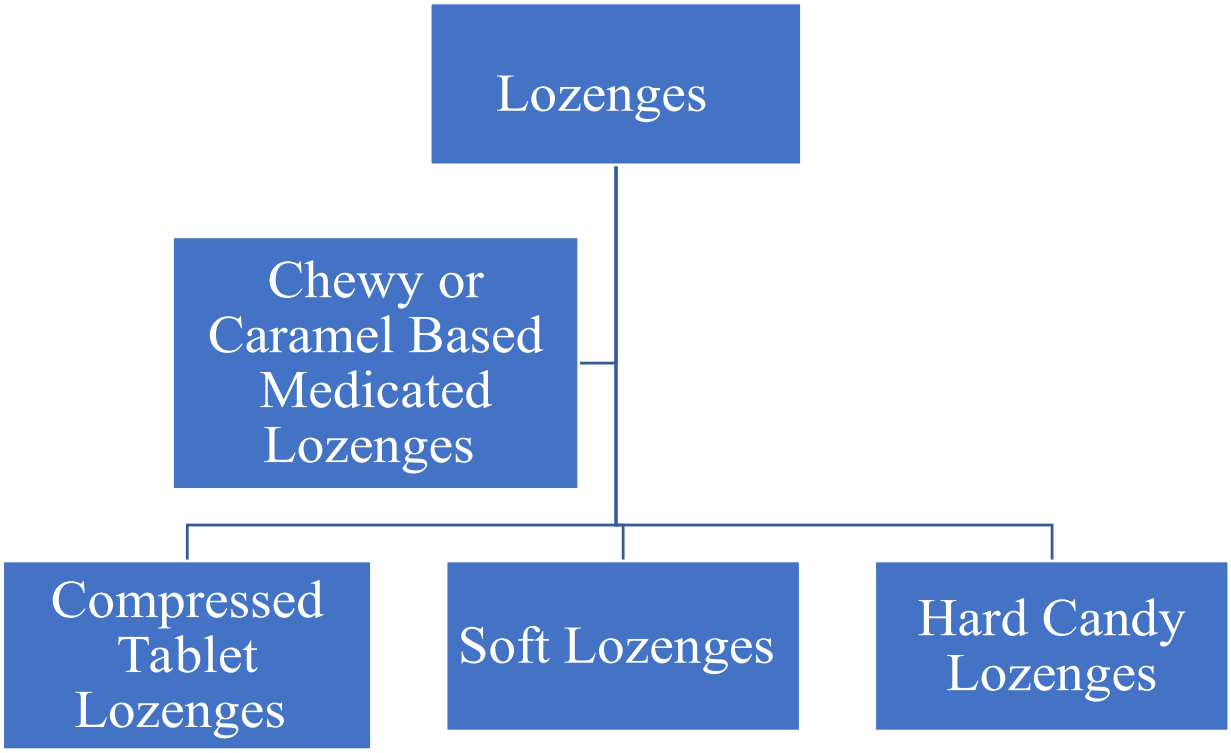


Figure 1.4. classification of lozenges according to texture and composition

Chewy or caramel based medicated lozenges: Are dosage forms that include medication mixed with a caramel base and chewed rather than melt in the mouth. These pastilles are usually fruit-flavoured and should have a slightly sour taste to mask the acrid glycerin flavor. Pediatric patients particularly prefer these lozenges for their very effective means of administration, for their gastrointestinal absorption and for their systemic usage. The tender lozenge, or 'gummy type candy pills, is one of the more well-known tablets among children and infants. By pouring the melt into molds or out onto a sheet of uniform thickness, these gelatin-based troches were prepared. [14]

Hard Lozenges: these lozenges are combinations of sugar and other carbohydrates in a no crystalline or glassy condition. This type can be considered as solid syrups of sugars, historically these lozenges have been utilized for the ease of minor sore throat strain and irritation and have been used widely to provide some topical anesthetics and antibiotics. [14]

Soft Lozenges: They have become popular thanks to the ease of the extemporaneous mixture and applicability to a spacious diversity of drugs. These bases commonly made up of a preparation of many polyethylene glycols, acacia or equivalent substances. The pastille is one form of these soft preparations, which is marked as a soft variety of lozenge, normally transparent, containing a gelatinous medication, glycerol-gelatin or acacia, sucrose base. Soft pastilles may be pigmented and flavored and can be either slowly melted in the mouth or chewed, counting on the activity desired for the integrated drug. [11]

Compressed tablet lozenges: Dissimilar to the other 3 groups, tablets which are applied under the tongue and buccal tablets, compressed tablet lozenges are destined for systemic or local action (e.g., for the treatment of cold-related throat conditions). The main dissimilarity of these compressed lozenges from the oral lozenges mentioned above includes the oral cavity spot, where the remedy delivery should take place. [11-14]

CONCLUSION

Through the analyze of the first chapter, we studied Lozenges, one of the widely used solid dosage forms. They consist of medication and are intended to be buccal or in pharynx. Since 20th century, pastilles have been in use and are commercially produced. Lozenges deliver agreeable means of dosage form administration and carry excellent utility, however they may undergo certain inconveniences too. Both local and systemic administrations are convenient for lozenges and they incorporate a wide selection of active constituents. Lozenges at the moment currently ready for use in market are: Caramel based soft lozenges, hard candy lozenges and compressed tablet lozenges. [8,12]

Including Ukrainian market, the modern market involves numerous medications in the form in lozenges, in most cases OTC drugs.

Infectious and non-infectious diseases are usually accompanied by sore throat as the most common symptom. According to world standards throat inflammation treatment is mostly regulated by approaches as streptococcal nature diagnosing and the use of antibacterial therapy in a positive case. [3]

CHAPTER 2

OBJECTS AND RESEARCH METHODS

2.1. Choice of general research methodology

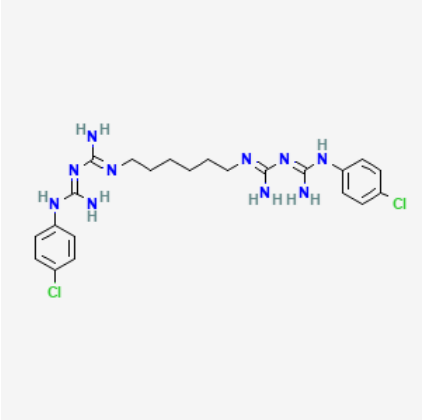


Figure 2.1. Chlorhexidine Molecular formula

Broad-spectrum antimicrobial biguanide such as chlorhexidine is used as a topical disinfectant, and in care and treatment of teeth for ease of inflammatory conditions caused by microorganisms and related to dental field. This antiseptic is one of the main skin and mucous membrane representatives used nowadays. The molecule itself is consisting of two 4-chlorophenyl rings and 2 biguanide groups joined by a central hexamethylene chain it is called a cationic bisguanide.

In the context, lozenges have gained significant attention as a patient-friendly administration form, because of rapidity in disintegrating and in releasing the drug they have been designed to.

In the same vein, and from a famous flowering plant (*Echinacea purpurea/Salvia Officinalis*), an important herbaceous extract and medication is derived, natively from the east of the Rocky Mountains in American States. Including sore throat, sage has been used often for treatment and prevention of the main cold and other upper respiratory diseases.

Selecting an appropriate research methodology to optimize the formulation and technology of lozenges with chlorhexidine / sage extract have a crucial importance, so it has been specifically highlighted in this review. [16]

In general, there could be stages as follows:

-Overview of lozenges

-significance of chlorhexidine and sage extract as active pharmaceutical ingredients

-Relevance of lozenges with chlorhexidine and sage extract

-Formulation scheme

-Characterization of excipients

-lozenges preparation techniques

-Evaluation of lozenges properties

Formulation design:

-Literature review

-Consideration of excipients

-Disintegration time and mechanical strength

-Drug release profile

Characterization of Excipients

- Physicochemical Properties of Excipients
- Compatibility Studies
- Excipient selection criteria

Lozenges Preparation Techniques

- Direct Compression Method
- Blending Techniques
- Compression Forces

Evaluation of lozenges Properties

- Weight Variation
- Thickness
- Hardness
- Friability
- Disintegration Time
- Drug Content Uniformity
- Dissolution Testing

The research methodology selection section discusses various aspects of the chosen research methodology, including formulation design, characterization of excipients, tablet preparation techniques, and evaluation of tablet properties.

The formulation design section explores the importance of conducting a literature review, considering excipients, and optimizing disintegration time, mechanical strength, and drug release profile.

The characterization of excipients section focuses on the evaluation of physicochemical properties, compatibility studies, and criteria for selecting suitable excipients.

The tablet preparation techniques section discusses the direct compression method, blending techniques, and the role of compression forces in achieving the desired tablet characteristics.

The evaluation of tablet properties section covers various quality attributes such as weight variation, thickness, hardness, friability, disintegration time, drug content uniformity, and dissolution testing.

Further research is needed to explore additional formulation strategies, such as the incorporation of novel excipients or the use of advanced manufacturing techniques like hot melt extrusion or spray drying. Additionally, studies on the stability of the formulated tablets under various storage conditions will provide

valuable insights into their shelf-life and potential for commercialization.

- Characterization of Excipients

Characterizing the excipients used in the formulation is crucial to ensure their compatibility and functionality. Physicochemical properties of excipients such as particle size, density, solubility, and hygroscopicity should be evaluated. Compatibility studies between sage extract, chlorhexidine and excipients should be conducted to identify any potential interactions that may affect the stability and efficacy of the formulation.

- lozenge Preparation Techniques

Any of the common tablet-processing methods, such as wet granulation, dry granulation, or direct compaction, may be utilized in the production of lozenge tablets. However, because the tablets should dissolve very slowly without disintegration, wet granulation is preferable because it generally provides better control. Through the judicious use of wet binders that retard dissolution, it should be possible to design a formulation having the appropriate dissolution rate. [18-21]

- Evaluation of lozenge Properties

The prepared lozenges were evaluated for parameters like drug content uniformity, hardness, thickness and diameter, weight variation, friability and in vitro dissolution test, drug content, moisture content analysis and stability. [22-27]

In conclusion, the development of lozenges with sage extract and chlorhexidine requires some critical stages designed to ensure consistency and efficacy of the final product. It requires a well-developed research methodology including formulation scheme, excipient characterization, lozenge preparation techniques, and comprehensive evaluation of lozenge properties. By selecting appropriate excipients, optimizing the tablet formulation, and employing suitable manufacturing techniques, it is possible to develop lozenges with enhanced hepatoprotective effects. The choice of research methodology plays a vital role in achieving the desired formulation characteristics and ensuring the quality, efficacy,

and patient acceptability of the final product.

2.2.Objects of research

The main object of research: are sage extract, Chlorhexidine, lozenges, auxiliary substances.

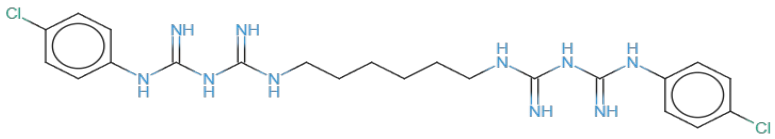


Figure 2.2. Chlorhexidine formula

The bisbiguanide compound with a structure containing two (p-chlorophenyl) guanidine units linked by a hexamethylene bridge called Chlorhexidine. It mainly serves as anti-infective and antibacterial agent. This member is the most popular antiseptic of biguanides and effectively a mono-chlorobenzene, so it is functionally related to biguanides. [28]

Back to the early 1950s, Chlorhexidine was developed in the United Kingdom by the ICI (Imperial Chemical Industries company) and was announced to the States of America in the 1970s. Suddenly, and due to a huge number of reports regarding chemical and thermal burns associated with the usage of chlorhexidine gluconate topical tincture 0.5% products containing, the FDA withdrew its authorization for the exploitation of chlorhexidine and other chlorhexidine containing formulations persist to be available in market. [34]

Antibacterial and bacteriostatic action against gram-positive and -negative bacteria, lipophilic viruses, and fungi are mainly the essential features bisbiguanides. Specifically, cationic bisbiguanides alike chlorhexidine (CHX) and chlorhexidine gluconate (CHG) possess a low mammalian toxicity, building

effective and safe usage as antibacterial agents. routine antiseptics and disinfectants as quaternary ammonium compounds, biguanides, and bisbiguanides are cationic antimicrobials, that have been actively used for years in medical fields along with daily life usage. in first aid, the long-term and vast application as a routine antiseptic and linen disinfection has bring on the creation of marketing accessible dressings based on BC, as an active substance the chronic burn wound management imparted thanks to its inhibitory action. [29]

Chemically, representing 97.97 % of the total essential oil of sage extract, the total of 49 constituents, that have been extracted from the leaves of the plant. In the table 1. relative percentages of the compounds of the volatile oil are recorded according to their Kovats index. The fraction of monoterpene in the oil was up to 75.93 % , the oxygen consisting monoterpenes are the largest group of this fraction with (48.43 %). Amounts of other components varied making the total content of sage extract's essential oil.

Table 2.1.

The compounds of the volatile oil and their relative percentages.

No.	Compound name	Kovats index	Peak area (%)
1	Alpha-thujene	935	0.36
2	Alpha-Pinene	940	0.84
3	Camphene	952	0.78
4	Sabinene	976	0.30
5	Beta-Pinene	979	0.85
6	Beta-Myrcene	991	1.93
7	Alpha-Terpinene	1019	0.30

8	1,8-cineole	1032	14.14
9	eugenol	1035	0.28
10	Limonene	1040	1.43
11	y-Terpinene	1063	0.61
12	Alpha-terpinolene	1089	0.52
13	Linalool	1098	0.39
14	Alpha-Thujone	1117	18.83
15	Beta-Thujone	1121	4.46
16	Camphor	1145	25.14
17	borneol	1169	2.81
18	Terpinen-4-ol	1179	0.74
19	Alpha-terpineol	1191	1.33
20	Naphtalene	1197	0.20
21	Myrtenol	1200	0.30
22	Bornyl acetate alpha	1288	1.05
23	Carvacrol	1299	0.18
24	Beta-Patchoulene	1367	0.42
25	Alpha-copaene	1378	0.07
26	Alpha-Bourbonene	1380	0.12
27	Beta-Bourbonen	1384	0.29
28	Alpha-Gurjenene	1409	0.17

29	Sinularene	1415	0.17
30	Identified components (%)		97.97
31	Monoterpene hydro-carbons ($C_{10}H_{16}O$)		48.43

2.3. Research methods

The following research methods were used during the experimental studies: microscopy methods, studies of fractional composition, bulk density, friability, fluidity.

CHAPTER 3

DEVELOPMENT TECHNOLOGIES OF TABLETS AND THEIR RESEARCH

3.1. Development of tablet composition and technology

Wet granulation; dry granulation or direct compaction, any of these usual tablet-development procedures, may be used in the production of lozenges. **nevertheless**, because the importance of the slow process of dissolvement of lozenges tablets without disintegration, wet granulation is preferred thanks to the better control it generally provides. It is possible to form a formulation with an appropriate dissolution rate through the judicious use of wet binders that delay the dissolution. [9]

In addition to smoothness and good mouth feel, development of slow dissolution lozenges requires accurate selection of appropriate excipients and careful method of development to be guaranteed that the controlling variables are handled correctly. Manufacturing of lozenges requires numerous key aspects that are critical to all the required performance attributes of the final product. This includes ensuring the necessary particle size and distribution, maintaining the correct moisture content, and achieving the proper hardness of the tablet. The process of development and scaling considerations must be thoroughly explored to ensure proper specifications for these standards.

Table 3.1.

Excipients used in tablet composition

No.	Ingredients	Examples
1	a) Sugar free vehicles b) Sugar c) Fillers	sucrose, maltose, mannitol, polyethylene glycol (PEG) 600 and 800. sorbitol, Dicalcium phosphate lactose, calcium sulfate, Dextrose, calcium carbonate, lactose, microcrystalline

		cellulose.
2	Lubricants	Magnesium stearate, calcium stearate, stearic acid and PEG, vegetable oils and fats.
3	Binders	Acacia, corn syrup, sugar syrup, gelatin, polyvinyl pyrrolidone, tragacanth and methylcellulose.
4	Coloring agents	Water soluble and lacolene dyes, FD & C colors, orange color paste, red color cubes, etc.
5	Flavoring agents	cherry flavor, eucalyptus oil, spearmint, Menthol, etc.
6	Whipping agents	egg albumin, xanthan gum, starch, gelatin, pectin, algin and carrageenan, Milk protein,
7	Humectants	Glycerin, propylene glycol and sorbitol.

Selection of Flavoring agents:

Clearly hard lozenges focus on the drug slow and consistent release directly toward the affected mucosa. An extra challenge is performed to the compounding pharmacist to prepare flavor blends that efficiently cover any undesirable preparations contributed by the pharmaceuticals, while smoothness and texture of surface of the lozenge should be maintained during the slow dissolvement of the tablet. Flavoring will not be a problem since the incorporated drug has no noticeable taste. However, priority should be placed on limiting the savor in order to improve patient's experience especially if the medication is strong-flavored and has a disagreeable taste. Flavor is a very complex phenomenon that is made up of 4 primary tastes: sweet, bitter, sour and salty. It is a mixture of the sensations including: taste, touch, smell, sight and sound. The first of these, flavor. [18-21]

Chemical Methods: These approved methods involve the adsorption and installation of the active drug to the material, resulting in a decrease of the unacceptable taste.

Physiological Methods: Menthol and mint impart anesthetic effect giving

them a crucial role in these methods, so they can be used enhance taste and making it more palatable. Flavoring materials are very complex preparations.

The following table illustrates several chemicals that may be included in both natural and synthetic flavors. (table 3.2.)

Table 3.2.

Flavoring agents

Flavor	Examples
Bitter	Spice Wild Cherry, Licorice, Chocolate Mint, Grape fruit, Coffee, Cherry, Peach,
Acrid	Raspberry, Orange, Lemon, Lime
Sour	Raspberry, Fruits, Berries, Acacia
Oily	Syrup
Sweet	Peppermint, Anise, Wintergreen
Acrid	Fruit, Berry, Vanilla
Metallic	Citrus Berries, Mint, Grape, Marshmallow

Choosing desirable mold

Types of molds used for development of Lozenges are:

a) Flat
b) Circular
c) Octagonal
d) Cylindrical

Figure 3.1. a mold used for preparing lozenges

Method of preparation of Lozenges

The technique used → heating and congealing

⇩

Combine sugar, corn syrup and water by heating

⇩

Addition of drug to this candy matrix

⇩

Addition of polymer, color, flavor, ect.

⇩

Poured into mold of admired shape and size to forming a candy

⇩

Sealing and wrapping of candy in polyethylene wrapping

Evaluation of Lozenges

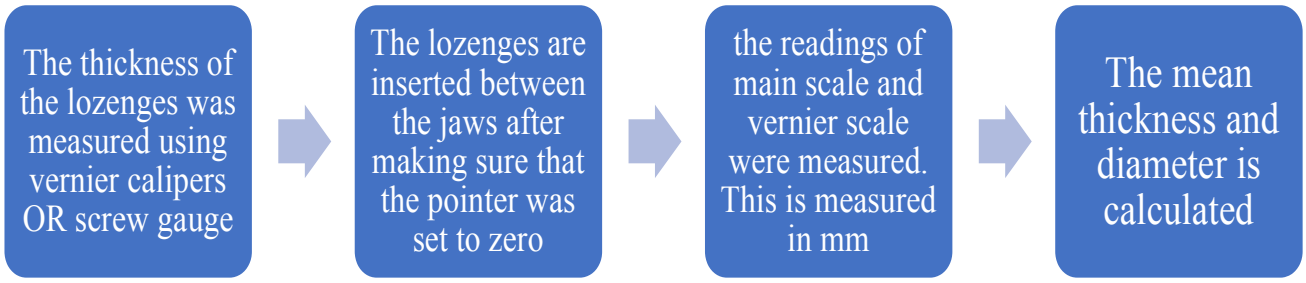
Considered parameters like drug content, hardness, thickness and diameter, weight variation, friability and in vitro dissolution test, drug content, moisture content analysis and stability were evaluating the prepared lozenges.

Hardness testing

A force required to break the lozenge should be distinguished while measuring the hardness of lozenges, utilizing either Monsanto Hardness Tester or Pfizer Hardness Tester.

Figure 3.2. a Pfizer Hardness Tester

Thickness & Diameter checking



Weight variation

Individual parts of a product, such as herbal lozenges, as expected, varies in weight. Evaluating weight differentiation of these lozenges has huge importance to ensure that each lozenge consist of a significant amount of active substance and to guarantee consistency in product quality. To complete the process of evaluating

weight variation of these lozenges, a sample is selected from a batch, then independently lozenges are deliberated using an accurate electronic balance. the weight variation is calculated using formula:

$$\text{weight variation} \quad \frac{average\ weight - initial\ weight}{Average\ weight} \quad \text{x } 100$$

Friability testing

The lozenges are taken on a friabilator and are operated for 4 min at 25rpm

Then the lozenges are taken after 4 minutes after that they are made free from dust and reweighed

finally the % friability and loss percentage is calculated

Figure 3.3. friability tester

Percentage of friability is calculated using the formula:

$$\text{Percentage friability } \frac{Initial\ Wt - Final\ Wt}{Initial\ weight} \text{ x } 100\%$$

In vitro drug dissolution

At 100 rpm and 37 ± 0.50 c PH 6.8 buffer containing 2% SLS, and using USP dissolution apparatus paddle type (type II), the medium for in vitro disintegration studies. Each flask of paddle apparatus was supplied with a lozenge and then 5ml samples were withdrawn at predefined time travels estimated of 60minutes. An equal volume of medium was replaced in order to maintain sink conditions. Specific nm and percentage drug released was calculated after the sample was analyzed by using UV Visible spectrophotometer.

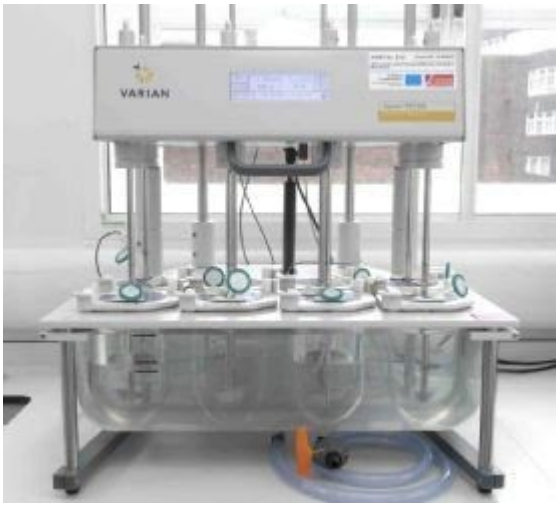


Figure 3.4. An USP dissolution test apparatus type II

Figure 3.5. An UV Vis Spectrophotometer

Analysis of moisture content

Helium Moisture Balance apparatus is used to determine the moisture content in the final product (lozenges). 1gm of the sample taken was smashed in a mortar then placed in a desiccator for 1day, the moisture content is determined by moisture balance apparatus after reweighing the sample. [13]

Figure 3.6. Moisture analyzer apparatus

Measurement of PH:

On of valuable parameter to evaluate lozenges is pH measurement. It is a mensuration of the alkalimetry or acidity of a solution that can have an evident effect on the stability, efficacy, and vital properties of the final product. Either pH meter or pH paper can be used to determine pH of lozenges. Solution resulting from a small dissolved amount of a lozenge in water, gives opportunity to the pH measurement. Frequently, the pH range of 5.5 to 7.5 can be satisfactory for most types of lozenges. Still, there is no exact pH range for lozenges, actually it counts on the particular product and its planned use. [13]

Figure 3.7. a pH Meter

Stability Test

An eminent component of product development for lozenges is stability testing. Over time and under various storage conditions, this parameter is used to assess the chemical, physical, and microbiological properties of the final product. Factors such as temperature, humidity, light, and oxygen exposure eventually effect the stability of lozenges.

Mouth dissolving time test

The temporal length of complete dissolution of a lozenge was determined using the USP disintegration apparatus (Figure 8.) Time taken for the lozenge to dissolve was acclaimed using phosphate buffer of pH 6.4 at 370c, where pastilles were placed in each tube of the apparatus (the test should be performed 3 times), then the average dissolving time was calculated and standard deviation was presented.

Microbial check

This parameter focuses on checking any bacterial, mold or spore contamination in raw materials, final products, devices, environmental conditions and storage racks. Laboratory microbial checking should involve the coming content:

- The total plate
- The total coliform
- Yeast and mold
- E. coli
- Staphylococcus
- Salmonella

Packaging

A complex and multiple packaging is adopted since the preparations are hygroscopic in nature. The polymeric moisture barrier material is used to wrap the particular unit, then arranged in a moisture resistant glass, polyvinyl chloride or metal container that is over wrapped by aluminum foil or cellophane membrane.

Storage

Storage of these preparations should be taken away from heat and out of the reach of children, and should be preserved from humidity. Generally, room temperature or refrigerated temperature is indicated either for the drug and base

depending on the storage requirement. [17]

Dispensing

The patient should be provided with accurate counselling about the purpose of hard lozenges, which is to afford a slow-acting, persistent delivery of the drug over a prolonged period of time. In the other hand, soft and chewable lozenges meant to be administered directly and not treated as candy. Certainly, they should be kept out of the reach of children. [17]

Result and Implementation

Macroscopic examination**:** point to the evaluation of sensory properties similar to taste, odor, and appearance of the final product. Lozenges are examined using the following organoleptic parameters: [32].

- Appearance: each of the color, size, and shape of the lozenges are evaluated. The external texture, speckles presence, and regularity of shape should also be checked out.
- Taste: lozenges taste should be assessed for: sweetness, sourness, bitterness, and saltiness. The aftertaste and mouth feel are also important to be evaluated.
- Odor: The aromatic herbal lozenges should be tested for intensity, quality, and pleasantness of the fragrance.
- Texture: The lozenges should be evaluated for hardness, chewiness, and stickiness. They should also be assessed if they dissolve easily in the mouth. [31]

3.2. Examples of formulations

Hard Lozenge

Formulation (for Thirty lozenges)

Drug ---------- 1 gm

Powdered sugar ---------- 42 gm

Corn Syrup ---------- 16 gm

Water ---------- 24 ml

Mint extracts ---------- 1.2 ml

Color ---------- q.s

Soft Lozenge

Formulation (for Ten Pastilles)

Drug ---------- 1gm

Polyethylene glycol1000 ---------- 10 gm

Aspartame ---------- 20 gm

Mint extracts ---------- 1 ml

Color ---------- q.s

Chewable Lozenges

Formulation (for fourty lozenges)

Drug ---------- 0.5 gm

Glycerin ---------- 70 ml

Gelatin ---------- 18 gm

Water ---------- 12 ml

Methylparaben ---------- 0.4 gm

Flavoring oil ---------- 3 to 4 drops

Color ---------- q.s

3.3. Example methodology of making lozenges

Ingredients discription:

1. Jaggery: Saccharum officinarum Jaggery, also known as "Gur" in Hindi, is a type of non-centrifugal cane sugar. In herbal lozenges, it is a natural source of sweetness and binding agent.
2. Sugar: is used in herbal lozenges as a synthetic sweetener and binder. It hardens the lozenges by formation of caramel.
3. Tulsi: also known as holy basil, is an herb that has been traditionally served in medicine for its multiple health benefits. It is also known for its anti-inflammatory, anti-bacterial, and anti-viral properties, which makes it a regular ingredient in herbal remedies for respiratory ailments including coughs, cold and sore throat...
4. Licorice root: Licorice is a root extract from a plant of the Fabaceae family called Glycyrrhiza glabra. Soothing coughs and sore throats, reducing inflammation, and boosting the immune system are several properties of glycyrrhizic acid (GZA) extracted from the plant, it is also known for its sweet taste and medicinal properties. In herbal lozenges, licorice root can be used as a key ingredient.
5. Eucalyptus oil: lozenges use eucalyptus oil as a key ingredient to help ease the respiratory system coughing and congestion. It can also serve as sore throats cure and provides a cooling sensation that reduces inflammation.

6. Ginger: Zingiber officinale, In addition to respiratory ailments ease such as coughs and colds it is also known for its anti-inflammatory, analgesic, and antioxidant properties that make it a kay component in making herbal remedies for different health issues.
7. Ajwain: in herbal lozenges, ajwain help soothing and relieving coughs and sore throats. It also breaks up mucus in the respiratory system, which reduces congestion and promotes to breathe easier.
8. Clove: also known as Syzygium aromaticum, , it can be used to minimize respiratory system's inflammation. The essential oil of clove includes eugenol, which is a powerful antimicrobial agent effective against infections in the respiratory system.
9. Crystal menthol: a natural compound extracted from mint plants, especially from peppermint and spearmint. [30] in herbal lozenges it is used for its benefits against cough drops, sore throats and respiratory ailments.
10. Lemon: lemon can be used as a key ingredient to soothe and ease sore throats and coughs. the acidic properties of lemon lead to break up mucus and phlegm in the respiratory system. The high vitamin C load of lemon boosts the immune system and serves to attack infections. [30]

FORMULATION OF SOFT LOZENGES

Formulation Table:

Table 3.3.

Soft lozenges formulation

NO.	INGREDIENTS	QUANTITY
1	Jaggery	40mg
2	sugar	42mg
3	Tulsi	2ml
4	Liquorice	0.5mg

5	Lemon	4-5 drops
6	Ginger	4mg
7	Ajwain seeds	10ml
8	Eucalyptus	2drops
9	Clove	1ml
10	Crystal menthol	0.5mg
		TOTAL: 100mg

FORMULATION OF HARD LOZENGES

Formulation Table:

Table 3.4.

Hard lozenges formulation

NO.	INGREDIENTS	QUANTITY
1	Jaggery	90mg
2	sugar	42mg
3	Tulsi	2ml
4	Liquorice	1mg
5	Lemon	4-5 drops
6	Ginger	3mg
7	Ajwain	6.5ml
8	Eucalyptus	1drops
9	Clove	0.4ml
10	Crystal menthol	0.5mg
		TOTAL: 100mg

METHODOLOGY:

Soft lozenges:

1. Prepare a decoction of tulsi, liquorice, ginger, ajwain seeds, and clove.

2. Rinse the raw material and prepare a decoction (in 100ml distilled water).

3. After prepare a decoction extract the juice with the help of mesh

4. A marc and solvent is obtained.

5. Solvent containing tulsi, liquorice, ginger, ajwain, clove extract and mix thoroughly.

6. Extract the eucalyptus oil through Clevenger apparatus.

7. Then liquefy jaggery and sugar in different beaker at medium flame and after melting mix both of them together.

8. Then according to given quantity add menstrum into beaker containing base of lozenges.

9. Continue and mix thoroughly.

10. Add drops of eucalyptus oil.

11. Transfer the solution into mould for its perfect shaping.

12. Then keep it in a refrigerator for 1 to 2 days until it gets harder.

13. Soft lozenges are ready.

Hard lozenges:

1. Measure the raw material Fig.no. 17 soft lozenges
2. Take ajwain, clove, tulsi, ginger, liquorice and dry the ingredients through hot air oven to remove moisture content.
3. Arrange the Clevenger apparatus for eucalyptus oil.

4. After drying the ingredients powder them through mixer jar and then pass the powder through sieve to get finer particles to get dissolved easily.
5. Then on a medium flame liquefy jaggery until it gets melt.
6. During its melting time add accordingly ajwain, clove ginger and tulsi powder together.
7. Continue agitating the mixture and add required quantity of crystal menthol and drops of eucalyptus oil.
8. Keep the mould ready.
9. After mixing the entire ingredient transfer the mixture into mould for shaping then keep It at room temperature until it gets harder.
10. Sprinkle the cinnamon powder on lozenges to avoid getting sticky in humidity.
11. Then the hard lozenges are stored for one to two days in a refrigerator.

3.4. Example of preparation of s. officinalis lozenges

The wet granulation technic was adopted to prepare the granules. Dry excipients were blended and the dried mix was moistened with a suitable amount of 4.7% microcrystalline cellulose. And the wet mass was passed through sieves, and the granules were dried in an oven at 40 ± 2°C for 2 hours. The wet granules were sieved again through sieves. Calculated amount of S. officinalis fundamental oil was mixed with sorbitol and dried in the oven for 1 min at 40 ± 2°C. Next, powder containing fundamental oil was added to dried granules. The granules were lubricated with 3% magnesium stearate after that mint extract as a flavor and propylparaben as a preservative and antibacterial were added. The formulations were then compressed in a single-punch tableting machine.

Physicochemical characterization of tablets

The prepared tablets were examined for organoleptic parameters (color, taste, odor, and touch), hardness, friability, thickness, and weigh uniformity. [24]

Preparation of Chlorhexidine Hard Candy

Hard candy Lozenges were prepared similar to hard candies. The hard candy lozenges were prepared as per the formulate seen in Table 7. All the ingredients like sucrose, liquid glucose, color, and polymer except flavors were mixed along with the medicament and added to a runny mass of sugar. Now the mass is mixed thoroughly to get a uniform distribution of medication. Flavors were added when the temperature was brought to 40-45 °C. Now this semisolid mass was put into pre-lubricated molds and subjected to cold temperature. Then the hard candy lozenges were taken out from the molds and packed in aluminum foil pouches. The related drugs give bitter taste so in order to conceal this taste we included saccharin (artificial sweetener), Menthol (cooling agent) in the pre-seen formulations. [34]

CONCLUSIONS

Lozenges are natural remedies that present many benefits for a variety of disease like throat inflammation, cough, cold, and allergies. With rising consumer need for natural and organic products, growing interest in traditional medicine, increased studies and development, and diverse applications, the future of herbal lozenges is bright and quietly promising. As consumers become more aware of health importance, the market for herbal lozenges is likely to grow significantly, offering a natural and effective alternative to conventional medications. Moreover, with the constant research, it is expected that more advanced and effective herbal lozenges will be developed to deal with the expected growing demand for natural remedies. Herbal lozenges are a safe and effective option for those seeking fast and natural relief from common ailments.

The development of lozenges is an easy and time saving process. It's a development which is more organoleptically accepted by the pediatric patients. Medicated Lozenges serve as a perfect dosage form for children and infants. These will have additional advantages of patient compliance, convenience and comfort for efficient treatment including low dose, immediate onset of action, reduced dosage regimen and economy. It will also offer better innovative dosage form. Lozenges have an important position in pharmacy and will remain the same in future.

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Level of higher education master
Specialty 226 Pharmacy, industrial pharmacy
Educational and professional program Pharmacy

APPROVED
The Head of Department
Industrial technology of
medicines and cosmetics

_____
Olena RUBAN

"02" September 2024

ASSIGNMENT
FOR QUALIFICATION WORK
OF AN APPLICANT FOR HIGHER EDUCATION

Hamza AHDIDI

1. Topic of qualification work: «Development of the composition of tablets for the treatment of throat inflammation based on sage extract and chlorhexidine», supervisor of qualification work: Oleksandr KUKHTENKO, Dr.Sc. (Pharm), professor

approved by order of NUPh from "27" of September 2024 № 237

2. Deadline for submission of qualification work by the applicant for higher education: May 2025.

3. Outgoing data for qualification work: to develop the composition of tablets for the treatment of sore throat based on sage extract and chlorhexidine

4. Contents of the settlement and explanatory note (list of questions that need to be developed): introduction, literature review, objects and methods of research, experimental part, conclusions, list of used sources

5. List of graphic material (with exact indication of the required drawings):
tables – 5

6. Consultants of chapters of qualification work

Chapters	Name, SURNAME, position of consultant	Signature, date	
		assignment was issued	assignment was received
1	Oleksandr KUKHTENKO, Dr.Sc. (Pharm), professor of higher education institution of department Industrial technology of medicines and cosmetics	09.09.2024	09.09.2024
2	Oleksandr KUKHTENKO, Dr.Sc. (Pharm), professor of higher education institution of department Industrial technology of medicines and cosmetics	18.11.2024	18.11.2024
3	Oleksandr KUKHTENKO, Dr.Sc. (Pharm), professor of higher education institution of department Industrial technology of medicines and cosmetics	03.02.2025	03.02.2025

7. Date of issue of the assignment: «02» September 2024.

CALENDAR PLAN

№ з/п	Name of stages of qualification work	Deadline for the stages of qualification work	Notes
1	Preparation of literature review	September 2024	**done**
2	Experiment planning	October-December 2024	**done**
3	Conducting an experiment	January-March 2025	**done**
4	Registration of results	April 2025	**done**
5	Submission to the examination commission	May 2025	**done**

An applicant of higher education _____ Hamza AHDIDI

Supervisor of qualification work _____ Oleksandr KUKHTENKO

ВИТЯГ З НАКАЗУ № 237

По Національному фармацевтичному університету

від 27 вересня 2024 року

Затвердити теми кваліфікаційних робіт здобувачам вищої освіти 5-го курсу Фм20(4,10д) 2024-2025 навчального року, освітньо-професійної програми – Фармація, другого (магістерського) рівня вищої освіти, спеціальності 226 – Фармація, промислова фармація, галузь знань 22 Охорона здоров'я, денна форма здобуття освіти (термін навчання 4 роки 10 місяців), які навчаються за контрактом (мова навчання англійська та українська) згідно з додатком № 1.

Прізвище, ім'я здобувача вищої освіти	Тема кваліфікаційної роботи		Посада, прізвище та ініціали керівника	Рецензент кваліфікаційної роботи
по кафедрі промислової технології ліків та косметичних засобів				
Ахдіді Хамза	Розробка складу таблеток на основі екстракту шавлії та хлоргексидину	Development of the composition of tablets based on sage extract and chlorhexidine	проф. Кухтенко О.С.	доц. Ковальов В.В.

Ректор

Вірно. Секретар

Україна Національний фармацевтичний університет Факультет підготовки іноземних громадян №02010936 місто Харків

ФА2.8-03-317

ВИСНОВОК

експертної комісії про проведену експертизу
щодо академічного плагіату у кваліфікаційній роботі

здобувача вищої освіти

«13» травня 2025 р. № 331186926

Проаналізувавши кваліфікаційну роботу здобувача вищої освіти Ахдіді Хамза, групи Фм20(4,10д.)англ-01, 226 Фармація, промислова фармація, освітньої програми «Фармація» навчання на тему: «Розробка складу таблеток на основі екстракту шавлії та хлоргексидину / Development of the composition of tablets based on sage extract and chlorhexidine», експертна комісія дійшла висновку, що робота, представлена до Екзаменаційної комісії для захисту, виконана самостійно і не містить елементів академічного плагіату (компіляції).

Голова комісії,
проректор ЗВО з НПР,
професор **Інна ВЛАДИМИРОВА**

Ф А 2.2.1-32-353

REVIEW

of scientific supervisor for the qualification work of the master's level of higher education of the specialty 226 Pharmacy, industrial pharmacy

Hamza AHDIDI

on the topic: **«Development of the composition of tablets for the treatment of throat inflammation based on sage extract and chlorhexidine»**

Relevance of the topic. The development of throat tablets based on sage and chlorhexidine is highly relevant, addressing the need for effective local treatments for throat inflammation. These ingredients provide a combination of antimicrobial and anti-inflammatory effects, making them ideal for managing sore throat symptoms.

Practical value of conclusions, recommendations and their validity. The study provides practical guidelines for tablet formulation, including excipient selection, optimization of physical properties, and stability testing. The results are directly applicable to small-scale production and further industrial scaling.

Assessment of work. The thesis demonstrates a systematic approach to formulation research, with well-structured experimental sections and clear data presentation. The author effectively addressed the challenges of taste masking, stability, and dissolution.

General conclusion and recommendations on admission to defend. The qualification work of the applicant meets the established requirements, demonstrates a high level of scientific competence, and is recommended for official defense before the examination commission of the National University of Pharmacy.

Scientific supervisor _____ Oleksandr KUKHTENKO

« 15 » of May 2025

Ф А 2.2.1-32-356

REVIEW

for qualification work of the master's level of higher education, specialty 226 Pharmacy, industrial pharmacy

Hamza AHDIDI

on the topic: **«Development of the composition of tablets for the treatment of throat inflammation based on sage extract and chlorhexidine»**

Relevance of the topic. The development of throat tablets with sage and chlorhexidine is highly relevant, given the rising demand for effective local therapies. These components provide a combination of antimicrobial and anti-inflammatory effects, making them well-suited for treating throat infections.

Theoretical level of work. The thesis demonstrates a strong theoretical foundation, covering the pharmacological properties of sage and chlorhexidine. The author effectively reviewed the current literature and technologies, providing a clear basis for formulation design.

Author's suggestions on the research topic. The work presents practical approaches to improving tablet formulations, including optimizing excipient selection and adjusting manufacturing parameters. The author's choices address challenges such as taste masking, stability, and patient acceptability.

Practical value of conclusions, recommendations and their validity. The study offers practical insights into the production of throat tablets, including detailed guidelines for formulation optimization. These findings are applicable to both small-scale production and potential industrial scaling.

Disadvantages of work. Some sections could benefit from more precise language and clearer data presentation. However, these minor issues do not significantly affect the overall scientific quality of the work.

General conclusion and assessment of the work. The qualification work of the applicant deserves high marks, meets the requirements and can be submitted for official defense to the examination commission of the National University of Pharmacy.

Reviewer _____ assoc. prof. Volodymyr KOVALOV

« 15 » of May 2025

Ф А2.2.1-91-287

МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ

Витяг з протоколу
засідання кафедри технологій фармацевтичних препаратів НФаУ
№ 12 від 16 травня 2025 року

Голова: завідувачка кафедри, доктор фарм. наук, проф. Рубан О. А.

Секретар: к. фарм. н., доц. Січкар А. А.

ПРИСУТНІ: зав. каф., проф. Рубан О.А., проф. Ковалевська І.В., проф. Бобрицька Л.О., проф. Гриценко В.І., проф. Сліпченко Г.Д., проф. Кухтенко О. С., доц. Безрукавий Є. А., доц. Кутова О. В., доц. Манський О. А., доц. Ніколайчук Н. О., доц. Пуляєв Д.С., доц. Січкар А. А., доц. Солдатов Д. П., доц. Трутаєв С. І., ас. Пономаренко Т.О.

ПОРЯДОК ДЕННИЙ:
1. Про представлення до захисту в Екзаменаційну комісію кваліфікаційних робіт здобувачів вищої освіти випускного курсу НФаУ 2025 року випуску

СЛУХАЛИ: Про представлення до захисту в Екзаменаційній комісії кваліфікаційної роботи на тему: «Розробка складу таблеток для лікування запалення горла на основі екстракту шавлії та хлоргексидину»

здобувача вищої освіти випускного курсу Фм20(4,10д.)англ-01 групи НФаУ 2025 року випуску _____Хамза АХДІДІ_____
(ім'я, прізвище)

Науковий (-ві) керівник (-ки)_д.фарм.н., проф. Олександр КУХТЕНКО_____
Рецензент_____к.фарм.н., доц. Володимир КОВАЛЬОВ_____

УХВАЛИЛИ: Рекомендувати до захисту кваліфікаційну роботу здобувача вищої освіти _5_ курсу _Фм20(4,10д.)англ-01__групи___Хамза АХДІДІ__
(ім'я, прізвище)

на тему:__«Розробка складу таблеток для лікування запалення горла на основі екстракту шавлії та хлоргексидину»

Голова
завідувачка кафедри,
доктор фарм. наук, проф. _____ Олена РУБАН
(підпис)

Секретар
к. фарм. н., доцент _____ Антоніна СІЧКАР
(підпис)

Ф А2.2.1-32-042

НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ

ПОДАННЯ
ГОЛОВІ ЕКЗАМЕНАЦІЙНОЇ КОМІСІЇ
ЩОДО ЗАХИСТУ КВАЛІФІКАЦІЙНОЇ РОБОТИ

Направляється здобувач вищої освіти Хамза АХДІДІ до захисту кваліфікаційної роботи
за галуззю знань 22 Охорона здоров'я
спеціальністю 226 Фармація, промислова фармація
освітньо-професійною програмою Фармація
на тему: «Розробка складу таблеток для лікування запалення горла на основі екстракту шавлії та хлоргексидину».

Кваліфікаційна робота і рецензія додаються.

Декан факультету _____ / Микола ГОЛІК /

Висновок керівника кваліфікаційної роботи

Здобувач вищої освіти Хамза АХДІДІ виконав кваліфікаційну роботу на високому рівні, з логічним викладенням матеріалу та обговоренням, оформлення роботи відповідає вимогам НФаУ до випускних кваліфікаційних робіт та робота може бути рекомендована до захисту в ЕК НФаУ.

Керівник кваліфікаційної роботи

_____ Олександр КУХТЕНКО

« 15 » of May 2025 р.

Висновок кафедри про кваліфікаційну роботу

Кваліфікаційну роботу розглянуто. Здобувач вищої освіти Хамза АХДІДІ допускається до захисту даної кваліфікаційної роботи в Екзаменаційній комісії.

Завідувачка кафедри
технологій фармацевтичних препаратів

_____ Олена РУБАН

« 16 » of May 2025 року

Qualification work was defended

of Examination commission on

« ___ » _of June_ 2025

With the grade _____

Head of the State Examination commission,

DPharmSc, Professor

_____ / Volodymyr YAKOVENKO /