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MINISTRY OF HEALTH OF UKRAINE

NATIONAL UNIVERSITY OF PHARMACY

faculty for foreign citizens' education

pharmaceutical technology of drugs department

QUALIFICATION WORK

on the topic: «**DEVELOPMENT OF THE COMPOSITION OF EMULSION WITH CALAMINEOF PHARMACEUTICAL PRODUCTION»**

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ANNOTATION

Qualification work is devoted to the research to develop the composition of extemporal emulsion which includes calamine in its composition.

The qualification work is set out on 51 pages of typewritten text, consists of an introduction, three chapters, general conclusions, a list of references and 3 appendixes. The bibliography contains 41 sources. The work is illustrated with 3 tables and 10 figures.

Key words: calamine, emulsion, emulsifier, suspension type, technology.

АНОТАЦІЯ

Кваліфікаційна робота присвячена дослідженням з розробки складу емульсії екстемпорального виробництва, до складу якої входить каламін.

Кваліфікаційна робота викладена на 51 сторінці машинописного тексту, складається зі вступу, трьох розділів, загальних висновків, списку використаних літературних джерел і 3^{х} додатків. Список літератури містить 41 джерело. Робота ілюстрована 3^{ма} таблицями та 10^{ма} рисунками.

Ключові слова: каламін, емульсія, емульгатор, суспензійний тип, технологія.

CONTENTS

LIST OF CONVENTIONAL ABBREVIATIONS

API – Active pharmaceutical ingredient

BAS – biologically active substance

BP – British Pharmacopoeia

WHO – World Health Organization

SPU – State Pharmacopoeia of Ukraine

EP – European Pharmacopoeia

INTRODUCTION

Actuality of the topic. Medicines with calamine are modern, highly recommended remedies, intended for the complex treatment of various dermatological diseases, including infectious ones. Calamine remedies are used externally, effectively eliminating skin itching arising from various causes. For example, the lotion with calamine stops the itching of postoperative stitches that are healing. It is also used for itchy insect bites, skin rashes with some diseases, etc.

Calamine remedies cool, disinfect, relieve inflammation. One of their main properties is the formation of an effective protective barrier on the surface of the skin. Thanks to all this, the affected area quickly recovers.

Calamine remedies have a calming effect, quickly eliminates the symptoms of itching, inflammation, prevents the development of the pathological process, promotes the activation of the skin regeneration process.

Medicines with calamine are used in dermatological practice, in the treatment of diseases accompanied by itching of the skin. Therefore, they are prescribed in the complex treatment of chickenpox, eczema, and psoriasis. Used for dermatitis, acne, herpes. Used in the treatment of skin rashes, shingles, urticaria, rubella, etc.

Currently the pharmaceutical market of Ukraine lacks medicines with calamine as there are only 29 pharmacies (according to May 2023 research) where such medicines can be found. Therefore, the development of the medicine with calamine in the dosage form of emulsion is an actual and up-to-date direction of pharmaceutical studies.

The aim of our work is to develop the composition of extemporaneous emulsion, which contains calamine and zinc oxide.

Tasks of the study

To achieve the aim, the following tasks were set:

- conduct a biblio-semantic analysis of literary data regarding the characteristics of calamine;

- conduct an analysis of the range of medicines that contain calamine;
- develop the composition of emulsion, which contains calamine, and zinc oxide;
- justify the technology of emulsion, which contains calamine, and zinc oxide.

Object of study. Pharmaceutical development of emulsion based on such ingredients as calamine and zinc oxide.

Subject of study. Development of emulsion based on such ingredients as calamine and zinc oxide.

Methods of research. When solving the tasks set in the qualification work, bibliosemantic, well-known organoleptic (appearance, smell, color), organizational, economic and mathematical (statistical processing of results) research methods were used, which allow to objectively evaluate indicators of the investigated emulsion samples on based on experimentally obtained and statistically processed results.

Practical significance of the obtained results. A medicinal and cosmetic product with complex calming effect, anti-inflammatory and anti-itching effect based on such ingredients as calamine and zinc oxide, is offered.

Implementation of results and publication. Based on the materials of the qualification work, 1 abstract was published (see Appendix A).

Structure and scope of qualification work.

The qualification work is laid out on 51 pages of typewritten text, consists of an introduction, three sections, general conclusions, a list of used literary sources and 3 appendices. The bibliography contains 41 sources. The work is illustrated with 3 tables and 10 figures.

CHAPTER 1

CALAMINE: CHARACTERISTICS AND PECULIARITIES

1.1 Characteristics of calamine as an active pharmaceutical ingredient

Fig. 1.1 Calamine (API)

Calamine (fig. 1.1). Appearance description: pink powder. A mixture of zinc carbonate (more than 98%) and iron oxide (about 0.5%).

In cosmetology, calamine lotion is often used, which is used to soothe atopic, allergic, or simply irritated skin. Calamine is a key ingredient in creams and lotions to treat and relieve the symptoms of many skin conditions, and is an alternative to brilliant green solution for lubricating chickenpox rashes and for treating insect bites, cuts, and irritations [1, 8].

Two-phase remedies for point treatment of inflammations with pink powder at the bottom (based on calamine) are very popular now.

By using several calamine products, you enhance the overall effect.

Calamine works as part of any product (caring and decorative), so it can be used at any stage.

The source of calamine is a mineral - hemimorphite.

The most important property of calamine for oily skin is its ability to absorb and absorb various compounds, including the product of the sebaceous glands.

Calamine adsorbs excess fat from the surface of the skin, helps prevent inflammation. The skin takes on a fresher look, its tone evens out.

Calamine is also suitable for sensitive and allergy-prone skin, as it has a calming effect, relieves irritation and fights its cause.

Calamine reduces swelling of the skin, relieves redness, dries up inflammation, promotes the formation of a protective layer of the skin while reducing barrier functions.

Calamine visually brightens the skin (depending on concentration), this must be taken into account in makeup.

It is absolutely safe for any skin, but dry skin can dry out, this must be borne in mind and, if necessary, use pointwise or short-term [4, 7, 11, 26].

The color of calamine varies from white to light pink depending on the degree of purification. The pink color is due to the admixture of iron oxide, and it is this combination that gives the skin a delicate shade when using products with calamine.

The properties of calamine become more pronounced at high concentrations, which means that it should be in the first half of the ingredient list.

Calamine is a medicinal substance that can be used independently in the form of powder. As a cosmetic ingredient, calamine is used in products to fight inflammation, mainly of a bacterial and allergic nature.

As part of any cosmetics, calamine provides a quick and lasting calming effect. In particular, calamine powder is one of the main components of the classic calamine lotion, which is widely used to this day to relieve conditions such as redness, burning and itching of the skin. Synonyms: Calamine Powder, Calamine.

The action of calamine in cosmetics

Calamine is considered a multifunctional cosmetic component that can be used for various problems. Calamine is primarily an effective cosmetic product

that soothes the skin. In addition, calamine has antipruritic, drying, soothing and cooling effects. This active ingredient reduces puffiness, relieves inflammation and irritation of the skin, and also helps to activate the regenerative functions of the epidermis in order to quickly form a protective barrier after damage, preventing further exposure to irritating factors from the outside [27].

Calamine is one of the most absorbent and soothing bases known in dermatology and cosmetology. Calamine is traditionally used in medicated creams, lotions, and ointments as an antiseptic. So, calamine powder is one of the main components of the classic calamine lotion, which has long been widely used to relieve skin irritations. Calamine effectively relieves redness, burning and irritation of the skin. In addition to the fact that calamine powder has a pronounced antiseptic effect and effectively treats the skin from bacterial eruptions, it also has a gentle toning effect.

Despite the pronounced therapeutic effects, due to its low cost, this component can be used as an auxiliary substance. For example, calamine is used as a structure-forming component in creams with a protective and astringent effect, in dermatological lotions and hygienic powders. In some formulas, it also works as an absorbent, binder, and clouding agent. This component contributes to the formation of a special, smoother consistency of the cosmetic product, which can therefore provide good occlusion - create a thin protective film on the skin surface, which acts as a protection against environmental stressors.

Who is calamine indicated for?

The mild tonic and antiseptic effect of calamine primarily benefits problematic and oily skin prone to acne (although this component is very effective in combating acne, not only with acne). With excessive sebum regulation, calamine helps to eliminate the oily sheen of the skin, providing a lasting mattifying effect [4, 11].

At the same time, calamine is a very delicate ingredient, so it is used in large quantities in the manufacture of products for the care of sensitive and very delicate facial skin. Calamine also provides a local cooling effect.

Calamine is used in the treatment of a number of different skin diseases, including infectious ones - its effects are especially in demand for relieving the symptoms of psoriasis, chickenpox, and insect bites. With dermatological diseases of an allergic and viral nature (dermatitis, eczema, exacerbation of herpes, etc.), calamine prevents combing, infection and scarring. Also, this component helps to get rid of the itching that occurs in the area of postoperative sutures.

Calamine will be effective in a variety of situations related to inflammation:

- it instantly relieves itching (even the strongest);
- ideally removes redness, inflammation and swelling;
- helps skin regeneration and forms a protective barrier against the action of irritating factors;
- dries, soothes and cools the skin;
- acts as an antiseptic that prevents infection of damaged skin;
- prevents scratching, infection and scarring.

Who is contraindicated for calamine

Calamine has no specific contraindications. Strict contraindication - individual hypersensitivity reaction [4-6, 11, 18, 41].

Cosmetics containing calamine

Calamine is traditionally used in a variety of products for therapeutic facial skin care (creams, masks, powders), as part of sunscreens. It is used in the form of body powders, as part of therapeutic toothpastes, and in hygienic bath products, and in dry deodorants.

Calamine powder is one of the main components of classic calamine lotion. Historically, calamine was mixed with rose water to create a soothing mask, and this recipe is still used today. The classic calamine-based dermatological formula still includes substances of exclusively natural origin, such as zinc oxide and calamine, water (pure or pink), and glycerin. This recipe, which can vary from

formula to formula, is a fairly common remedy for making medicinal substances that are used to get rid of diaper rash and prickly heat in children [7, 11, 26].

1.2 Physical and chemical characteristics of calamine

Fig. 1.2 Hemimorphite

Hemimorphite (ancient Greek ἡμι- - semi- and μορφή - form) is a mineral of the silicate group, hydrous zinc silicate of an island structure (fig. 1.2). The name is associated with the “compressed” shape of the crystals. Synonym – calamine (Latin calamia). The international gemological abbreviation is gmm. It was first described as an independent mineral in 1853. Chemical formula is $Zn_4[Si_2O_7](OH)_2 \times H_2O$.

The crystals are tabular, often elongated. Birefringence +0.22. Dispersion, pleochroism are absent. The absorption spectrum is not interpreted. Luminescence is weak, uncharacteristic. Often in hemimorphite there is an alternation of white and blue stripes or dark inclusions of oxides of manganese, limonite and other minerals. Dissolves in hydrochloric acid. It has pyroelectric properties.

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Hemimorphite deposits are found in Algeria, Austria, Belgium, Great Britain, Germany (Aachen), Italy (Sardinia), Greece, Mexico (Chihuahua), USA (California, Montana, Nevada, Pennsylvania, Utah), Namibia, Central Kazakhstan (Akzhol, Kyzylesp, Gulyiat), Poland (Upper Silesia), Russia (Eastern Transbaikalia), Vietnam, China [1, 8, 33].

1.3 Theoretical basis of cosmetic emulsion preparation

In recent decades, significant changes in the chemical industry have emerged in response to an increasingly competitive globalized market (Cussler and Moggridge, 2011). The era of globalization has intensified competition generating strong market forces that play an essential role in the chemical industry (Smith and Ierapepritou, 2010). Among these market forces affecting new product strategies within the chemical industry, the most commonly found are global competitiveness, demand for product variety, and time-to-market pressure (Smith and Ierapepritou, 2010). Consequently, the chemical product industry has moved from the production of bulk commodities products toward higher value-added products, placing particular interest in the manufacture of specialty chemicals and consumer-oriented products (Cussler and Moggridge, 2011, Edwards, 2006). Chemical products are frequently categorized into basic, industrial, and configured-consumer products (Smith and Ierapepritou, 2010, Smith, 2005). Basic chemical products are obtained from natural resources (Smith, 2005), aiming to produce these products in large quantities at the lowest possible cost (Cussler and Moggridge, 2011). Examples of basic chemical products are ethylene, acetone, benzene, ammonia, and polyethylene. These basic products are utilized to start the production of industrial chemical products, which consists of mixtures of basic products blended and shaped into structured formulated products (Picchioni and Broekhuis, 2012). This category includes a great variety of products such as films, woven and nonwoven fibers, paper, creams, and pastes (Seider et al., 2009). Both the basic chemical and industrial chemical products are employed to produce

configured-consumer products. Some examples of configured-consumer products are pharmaceuticals, pesticides, drug-delivery patches, fuel cells, detergent, and cosmetics. Among configured-consumer products, consumer and pharmaceutical products are of significant concern, since they represent the main business of about 75% of the chemical industry in the United States (Wibowo and Ng, 2001). According to Muda et al. (2017), the global market size for the cosmetics, toiletry and fragrance industry was about USD 382 billion for 2010. Most of these configured-consumer products, especially those related to skincare, are manufactured in the form of emulsions due to the advantages that this presentation offers (Wibowo and Ng, 2001).

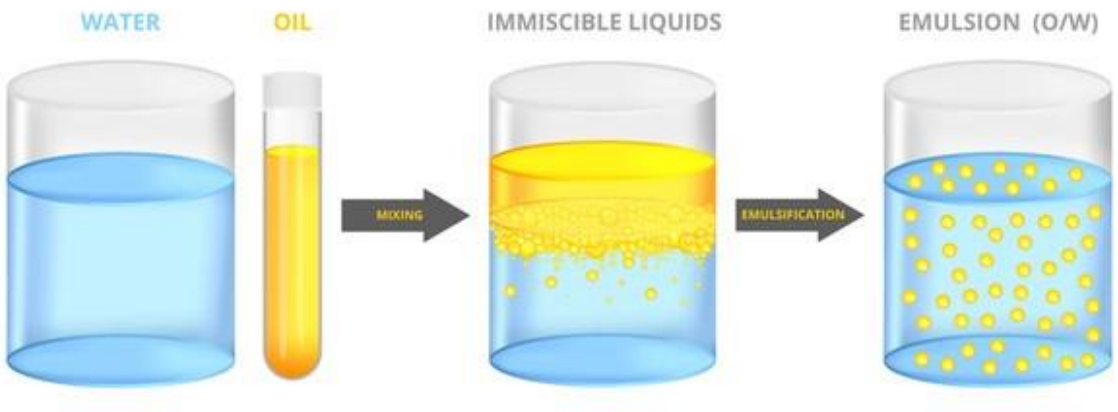


Fig. 1.3 Emulsion formation

Emulsions are thermodynamically unstable colloidal systems, in which there are droplets of a liquid dispersed in a second immiscible fluid. The use of emulsions in the industry has a vast number of applications at different sectors, such as cosmetic, food, petrochemical, pharmacy, biotechnology and nanotechnology (Masalova and Malkin, 2008, Desbrières et al., 2017, Villena de Francisco and García-Estepa, 2018, Zhu et al., 2018) leading to a great interest to understand the relationship between the formulation, the process variables, and the properties of these systems. A multi-scale approach, whose primary purpose is to understand the links between the different temporal and spatial scales within a

system and its overall impact on a finished product, is an appropriate way to study these relationships at different levels. As highlighted in previous studies (Braatz et al., 2006, Derkach, 2009, Sagis, 2011, Ricardez-Sandoval, 2011), these links are of significant importance for the design and development of new products. The design process could be addressed using different solution strategies, such as experiment-based (trial-and- error), model-based, and integrated approach (Conte et al., 2011). Recent studies have drawn particular attention to the application of an integrated approach to manage the design process of chemical products (Bernardo, 2016, Rafiei and Ricardez-Sandoval, 2020), e.g. emulsions. Integrated chemical product and process design denote the specification of a chemical-based product along with the design of the process required to manufacture the product (Bernardo, 2016). The integrated approach is the most appropriate compared to classical design methodologies such as trial-and-error and model-based approaches, as highlighted by previous reports (Conte et al., 2011) since one can achieve higher efficiency and reliability at manufacturing an emulsified product. This approach requires a combination of experimental techniques and computer-aided tools (Conte et al., 2011) to achieve an optimal solution to the design problem. Hence, notable advances have been achieved in the implementation of structural design principles to manufacture emulsions (McClements, 2012).

Currently, there is a need for the design of emulsified cosmetic products using an integrated approach, relating elements of the multi-scale approach of emulsion properties with the formulation and the process involved in the manufacturing of these systems. Emulsified products are often implemented as delivery vehicles in the cosmetic industry, since multiple components with different physical and chemical properties can be combined in this presentation (Wibowo and Ng, 2001). Also, the application of emulsified cosmetic products is easy and convenient, while they are effective at delivering small dosages of active ingredients (Wibowo and Ng, 2001). However, most of these products are still designed using heuristic or even artisanal considerations (Arrieta-Escobar et al., 2019). Consequently, an active area of research in this filed is focused on the

product properties, formulation, and preparation of emulsions through an integrated approach. In particular, studies have used model-based techniques to predict the properties of emulsions. Most of these studies have focused on the calculation of emulsion properties (e.g., viscosity) using an average value of the drop diameter rather than considering the actual droplets size distribution. The distributions for emulsions can be predicted using population balance models (PBMs). PBM is a proven method and represents a robust modeling framework for the description of the dynamics of properties characterized by distributions, as it is the case for emulsions droplets diameter (Nopens et al., 2015). Although considerable attention has been devoted to the study and implementation of PBMs in emulsions, there is a lack of studies linking this modeling framework with the integrated design approach of emulsified cosmetic products.

Cosmetic emulsions need to satisfy a number of benefits. For example, such systems should deliver a functional benefit such as cleaning (e.g. hair, skin, etc.), provide a protective barrier against water loss from the skin and in some cases they should screen out damaging UV light (in which case a sunscreen agent such as titania is incorporated in the emulsion). These systems should also impart a pleasant odourand make the skin feel smooth. Both oil-in-water (O/W) and water-in-oil (W/O) emulsions are used in cosmetic applications [3, 21, 22]. As will be discussed in Chapter 8, more complex systems such as multiple emulsions have been applied in recent years [9, 32].The main physicochemical characteristics that need to be controlled in cosmetic emulsions are their formation and stability on storage as well as their rheology, which controls spread ability and skin feel. The lifespan of most cosmetic and toiletry brands is relatively short(3–5years) and hence development of the product should be fast. For this reason, accelerated storage testing is needed for prediction of stability and change of rheology with time. These accelerated tests represent a challenge to the formulation chemist [13].

Emulsions are considered thermodynamically metastable systems, i.e., they can exist in a long lived-state that is not its most stable form. In fact, Gibbs stated, in reference to emulsion stability, “the only point in time where an emulsion is

stable is when it is completely separated.” In the real world, this implies that emulsions will always have a tendency to separate into their oil and water phases, although viscosity and stabilizing components slow this separation process.

The cloudy region in the emulsion is the manifestation of creaming in the system, where the oil droplets are attracted to each other. The upper yellow layer shows the oil phase, appearing after the oil droplets have coalesced. Creaming of the oil droplets can be reversed by re-mixing the emulsion; however, coalescence can only be reversed by re-formulating the emulsion.

Emulsifiers are molecules that contain both hydrophilic and lipophilic chemical groups. From a thermodynamic standpoint, the emulsifier reduces the surface energy of the dispersed phase, thus increasing the thermodynamic drive to form a stable emulsion. While droplet size, temperature and entropy also contribute to the thermodynamic stability of the emulsion, the use of emulsifiers provides a simple route to form a stable product.

Numerous types of emulsifiers are available and the selection criteria can be based on: chemical functionality—i.e., esters, silicones, ethoxylates, etc.; hydrophilic or lipophilic chemical behavior; efficiency; and/or cost. Further, Griffin defined the hydrophilic-lipophilic balance (HLB) theory to provide formulators with a tool to assist in the selection of the correct balance of emulsion system, although this theory is not without flaws or exceptions.3

When formulating an emulsion, one can tailor the texture, body and sensory characteristics of the finished product by choosing specific ingredients. Common ingredients used in emulsion systems are: water; oils/waxes; emulsifiers; emollients, often lipophilic; moisturizers, often hydrophilic; natural extracts; active ingredients; essential oils; fragrances, which are volatile and temperature-sensitive; preservatives; and colors or tints.

Conventional emulsion processing (fig. 1.4) involves separately mixing and heating water and oil phases, bringing the two phases together and mixing with high shear. In this case, temperature-sensitive ingredients must be added to the formulation once the emulsion has cooled. Why might heat be required to make an

emulsion? The aqueous phase may include a gum that must be hydrated at an elevated temperature; or the oil phase may contain waxes that require melting. Waxes and gums are used in emulsions to increase the viscosity of the oil phase, improve stability and enhance the aesthetics of an emulsion [9, 13].

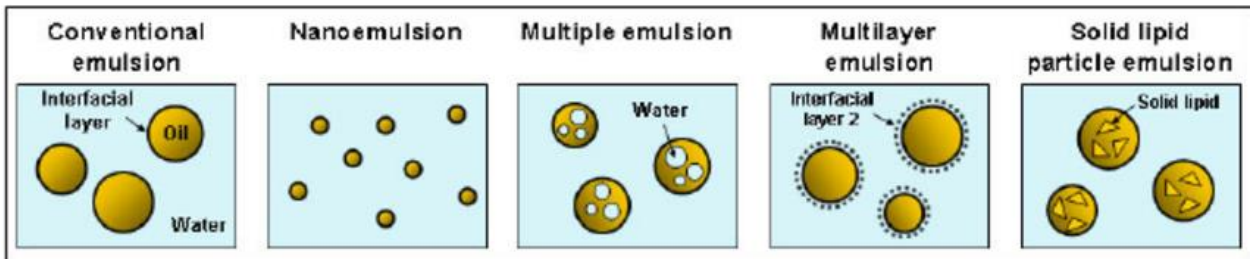


Fig. 1.4 Conventional emulsion

The drawbacks inherent with this process are the time and energy it takes to heat the two phases and the emulsion; although energy prices are on the rise, the largest cost component for the conventional manufacture of creams and lotions is the time involved for the heating and cooling stages of the process. In fact, it has been calculated that these stages account for nearly 40% of the total processing time.1 Another critique of the conventional process arises when processing a high viscosity cream, as the post-emulsification addition of temperature- and shear-sensitive ingredients, if using inefficient mixing systems, can lead to non-homogeneity within the finished formulation.

Cold process emulsions (fig. 1.5) are prepared from base raw materials preferably without any external heat—i.e., cold. In an ideal world, this process would simply involve premixing the oil and water phases separately, then bringing them together with an efficient mixing system. To successfully eliminate the requirement for heat in the process, all raw materials must be liquids or soluble within their respective phases at ambient temperature. In fact, any increase in temperature generated would only be the direct result of the mixing process. To some, the separate blending of emulsifiers and low melting of waxes and oils using heat could be considered part of this process; however, this author believes they cannot be considered part of a truly cold process [14, 29-31].

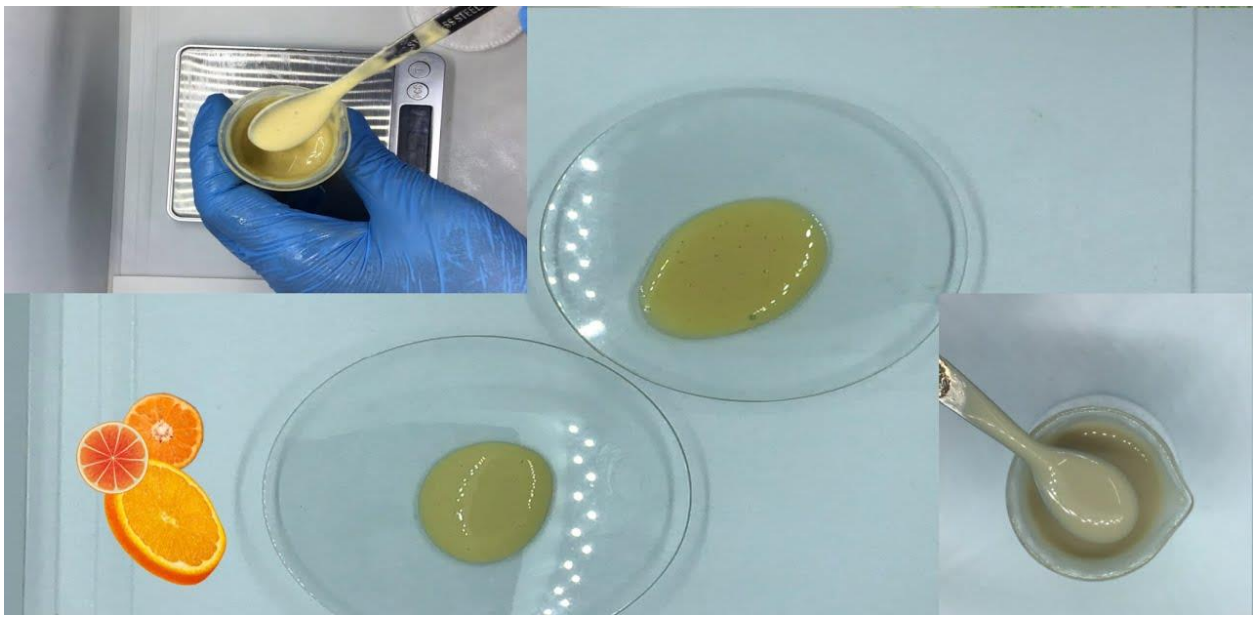


Fig. 1.5 Cold press emulsion with lecithin

Advantages of cold processing include reduced energy cost, manufacturing times and equipment costs; greater flexibility for formulation development; and the absence of deleterious effects on temperature and shear sensitive ingredients. Temperature and shear sensitive ingredients such as fragrances, active compounds, preservatives, etc., can be added to the relevant phase prior to forming the emulsion. Cold processing potentially allows the formulator to construct entire phases separately, and to simply bring them together with a suitable mixing system.

From a practical standpoint, taking a simple formulation of water, oil, emulsifiers, preservative, essential oil, plant extract, viscosity modifier, pH adjusters and a fragrance, the conventional process would require separately heating the oil and emulsifier; and the water, emulsifier and viscosity modifier; then bringing the two phases together with efficient mixing, and allowing the batch to cool. Once cold, the preservative, essential oil and plant extract could be added and finally, the pH adjusted to meet the product specifications. In contrast, cold processing allows all the oil-compatible components to be premixed in the oil phase, and likewise for the water-compatible components and the water phase. The

phases can then be mixed together and the pH adjusted to create the finished product in a fraction of the time [2].

Calculating the potential time and energy saved using cold emulsification is somewhat tricky and will be specific to an individual company's equipment. Dependent factors include: heater/chiller unit efficiency, cooling/heating demand of the system, flow rate through the heater chiller, cooling/heating transfer efficiency in the processing vessel, the ambient temperature's contribution to heating and cooling, the power rating of the stirrer motor and high shear mixer (if required), current energy pricing, batch size, viscosity of the product, local labor costs and overall time of processing. However, the potential cost savings could be in the order of thousands of dollars. As a simple example, the energy requirement to heat and cool 1 tonne of water from 20°C to 70°C and back is approximately 120 kWh, accounting for over 90% of the total energy consumption for processing an emulsion.

In addition, cold process emulsions require less equipment since external heating or cooling is not necessary. In the case of natural viscosity modifiers or powdered acrylates, however, efficient or high shear mixing systems may be required to ensure complete wetting of the thickener. An efficient mixing configuration is also needed when manufacturing higher viscosity emulsions, to ensure homogeneity of the finished product. Also for viscous creams, the ability to apply a partially positive pressure within the reaction vessel will facilitate emptying the product. In the case where wax is an essential component of the oil phase and some heat is required to melt it, blending the wax into a warm oil phase in a melt vessel prior to mixing in the cold bulk aqueous phase is an option and only necessitates heating one phase; however, the authors do not consider this to be a true cold process. For low viscosity emulsions, a fine, uniform droplet size is easily achievable using low shear stirring.

Readers should note there are some limitations to cold process formulating,5 including the fact that all raw materials must be liquid or readily soluble at room temperature. Waxes or wax-like materials cannot be incorporated into the oil

phase, and viscosity modifiers are required to achieve the desired body and feel in the end formulation. Also, pasteurization of natural viscosity modifiers cannot be employed as a means to remove any pre-existing microbes and bacteria. Further, the range of available emulsifiers is limited; cold process emulsifiers tend to have a specific purpose or application. However, there are ways to circumvent these issues [2, 16-19].

Viscosity modifiers: With respect to the development of texture and viscosity in the absence of waxes, numerous synthetic or natural viscosity modifiers are available that either immediately increase viscosity or require activation via pH adjustment or the addition of electrolytes. The range of thickeners available is large, including polyacrylate based thickeners that provide excellent texture, feel and viscosity; although one major drawback is their intolerance towards electrolytes. Another range of thickeners worthy of mention are cold process waxes.

Natural viscosity modifiers, such as xanthan or guar gums, often receive criticism for their finished texture and appearance and they also play host to a number of microbes and bacteria. Pasteurizing the water phase at 72°C is therefore the general method of choice for killing the microbes and bacteria. Unfortunately, this is not an option for true cold processing, but there are a number of preservatives and blends that provide a means to sterilize the system. One advantage of the cold process is that a robust formulation can tolerate the addition of preservatives early in the process. Hence, the judicious choice of preservative system and its early inclusion in the formulation will overcome these issues caused by natural viscosity modifiers [28, 29].

Emulsifiers: The number of cold process emulsifiers available is relatively small and has been exhaustively reviewed.5 Generally, they fall into distinct groups: those for o/w emulsions, often polyglycerol esters, or those for w/o emulsions, often alkoxylated alcohols and phosphorous compounds, and a small group of silicone based emulsifiers. Emulsifiers provide stability by reducing surface energy, although it has been noted that acrylate polymer thickeners can

hold the internal phase droplets in suspension. While the majority of cold process emulsifiers tend to have a specific application, one range of emulsifiers based on polyglycerol ester derivatives of vegetable oils has been developed that is compatible with both oil and water phases, allowing for the use of just one emulsifier.

As previously mentioned, emulsions are unstable systems, and all possess a thermodynamic drive to return to a state of lowest energy—i.e., to completely separate into the individual oil and water phases. It demonstrates flocculation and coalescence; however, other effects of emulsion instability include: sedimentation, which is similar to creaming except the denser phase settles to the bottom; flocculation, when oil droplets floc together to form a cloudy suspension; phase inversion; and Ostwald ripening.

Phase inversion: Phase inversion is said to occur when the emulsion inverts from one type to another, for example, an o/w inverts to a w/o emulsion. Phase inversion arises when the emulsifier becomes more soluble in the dispersed phase than in the continuous phase. Such changes can occur upon on change in temperature and/or increase in electrolyte content. While phase inversion can be considered emulsion system instability, it also can be used as an energy-efficient method to prepare a stable emulsion. In phase-inverted emulsions, the interfacial tension is extremely low at the inversion temperature, which relates to the existence of a micro emulsion phase at the temperature of inversion. This physical behavior results in the formation of very small droplets with little mechanical energy input [2, 16-19, 24].

Within the cold process paradigm, the ability to pre-mix individually homogenous phases is a prerequisite to applying the phase inversion technique. If the inversion from w/o to o/w occurs by reducing the temperature, the aqueous affinity of the emulsifier will increase as the temperature drops. Phase inversion can also be concentration-dependent; for example, a prepared oil phase containing an emollient, emulsifier and microemulsion booster4 will proceed through a phase inversion state as the level of water increases. It has been reported that for this oil

phase: below 10% water content, the product is a clear solution; between 10–32% water, a w/o emulsion forms; between 32–72%, a microemulsion forms; and above 72%, the emulsion reverts to an o/w type. While this is a specific example, it demonstrates that within the sphere of cold process emulsion science, the ratio of oil to water phase will have a significant impact on the type of emulsion formed. Since the physiochemical performance of emulsions varies with respect to components and their levels, it is difficult to develop a predictive rule to indicate that X oil phase plus Y water phase would give a specific emulsion type.

Ostwald ripening (fig. 1.6): Ostwald ripening tends to occur in solid solutions or liquid sols, where the small crystals or sol particles dissolve and redeposit themselves as larger particles. This is because, from a thermodynamic standpoint, larger particulates or droplets are more stable. In the case of emulsions, molecules diffuse from small droplets to form large ones within the continuous phase. Generally, Ostwald ripening occurs in w/o emulsions.

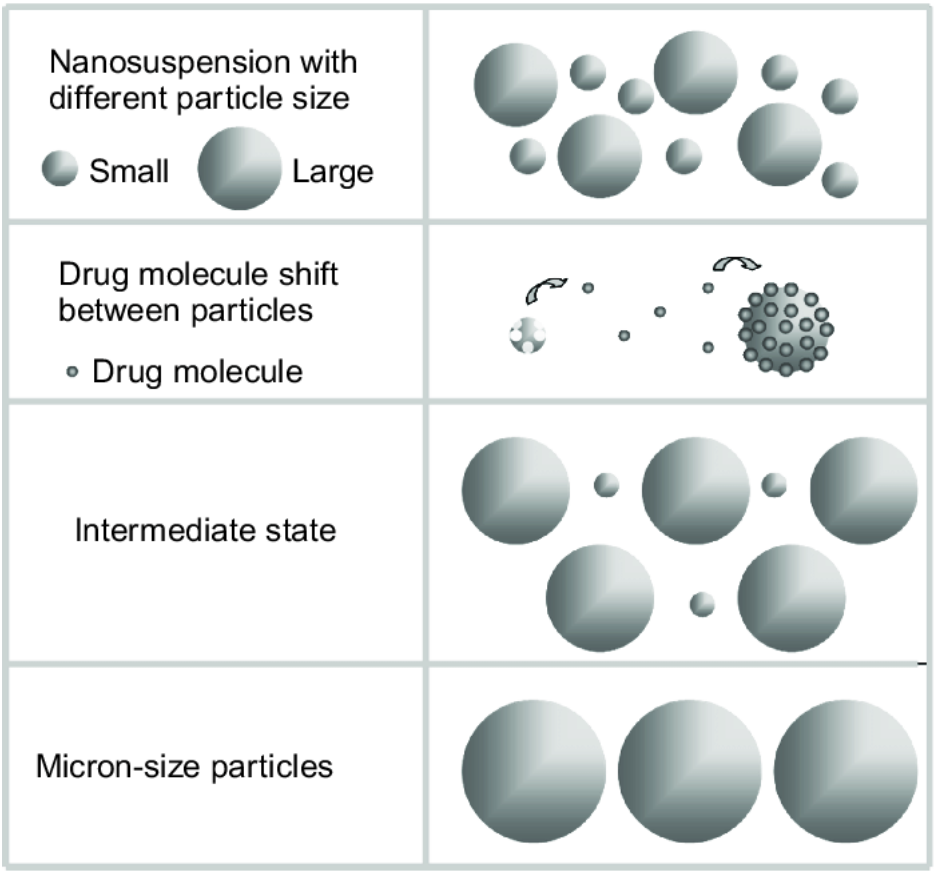


Fig. 1.6 Ostwald ripening

Stokes' law (fig. 1.7) is a mathematical expression relating the frictional force exerted on a sphere in a viscous medium. This expression supports the theory that the more viscous the formulation, the less likely the oil droplets will separate from the water phase. The increased viscosity reduces the mobility of the suspended droplets and reduces the capacity for flocculation and eventual coalescence. This theory also implies that the choice of viscosity modifier is critical for the successful formulation of cold process emulsions [2, 20, 27].

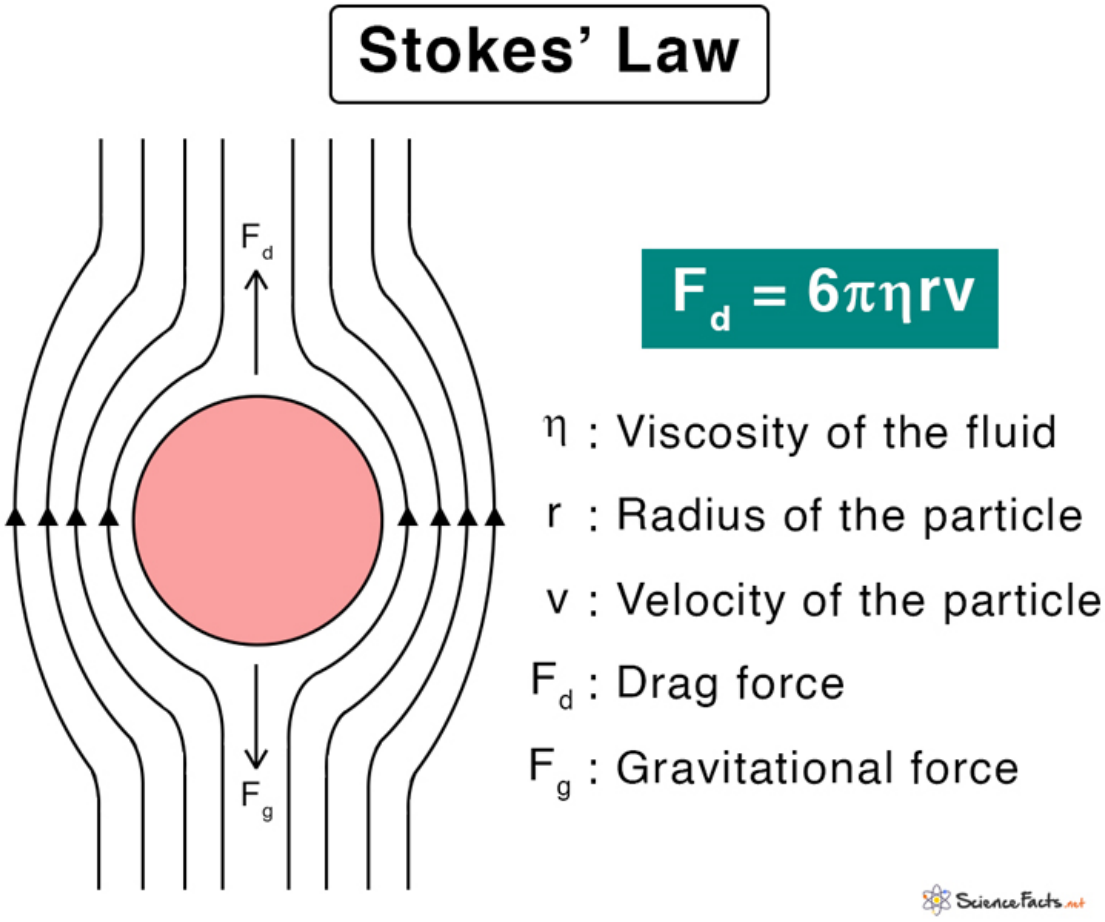


Fig. 1.7 Stokes' law

From the previous paragraph, the logical assumption would be that a stable, water-thin emulsion should be a difficult product to formulate. However, using emulsifiers, water, oil, preservative and a small amount of viscosity modifier, a water-thin emulsion was developed that demonstrates long-term stability. Generally, the micelle size distribution in emulsions can range from nanometer to micron scale and is influenced by numerous factors including ratio of the oil and

water phases, levels of emulsifiers, efficiency of mixing, etc. It shows the microscopy image of the same water-thin emulsion prepared by a heated process.

These images show there is little or no alteration in micelle size or distribution after storing the sample at 40°C for four weeks. Additionally, little or no difference in physical appearance between the two samples was observed.

The associated variations in preparing an emulsion, including formulation, stirring, ambient temperature, processing temperature, etc., all lead to emulsified products that may possess differing properties or characteristics. Therefore, careful control and processing conditions must be adhered to during all stages of any emulsion preparation.1 This means that for any meaningful comparison of emulsion systems, one must consider a single formulation prepared at different temperatures. An in-house panel test comprising of 37 members, when asked to consider rub-in, pick-up, texture, appearance, tack and skin feel, could not detect any difference between a hot-processed or cold-processed lotion.

Given the continual rising global energy costs, and the adoption of green policies by leading manufacturers, cold processing can assist the manufacturer in offsetting production costs and provide a route to directly reducing the carbon footprint of operations. Although the number of currently available cold process raw materials is limited, increasing interest in this technology will ultimately lead to greater offerings of such materials. Cold processing also provides a direct route to improve the speed of manufacture, therefore providing a measurable improvement in operational efficiencies. As more and more manufacturing companies determine a need for green initiatives, investment in research and development will increase the understanding of these advantages and their limitations, also raising the profile of the technology [16-19, 25, 27].

Further, the role of the formulator in developing cold-processed products will be critical. Namely, reproducibility must be ensured across the spectrum of research scale, pilot batch and full plant production. The focus must include key product performance factors including sensory and stability attributes. Also, one key ingredient to any cold-process formulation will be the viscosity modifier; be it

a melted wax, a synthetic polymer or a natural gum. This choice will significantly impact the product's appearance and performance. One particular advantage of this process for the formulator is the ability to include preservatives early in the preparation, which ensures the entire batch will be sterilized for nearly the entirety of its processing.

The potential for cold process technology is great, and in coming years, a greater understanding of the science will increase, along with the availability of compatible raw materials, ultimately leading to an increased number of cold-processed finished products [2].

Conclusions to chapter 1

1. Calamine as an active pharmaceutical ingredient is characterized. In particular, its physical and chemical properties and areas of use in medical, pharmaceutical and cosmetic practice are described.

2. Data from literary sources on the theoretical foundations of the production of cosmetic emulsions were analyzed.

CHAPTER 2

OBJECTS AND METHODS OF RESEARCH

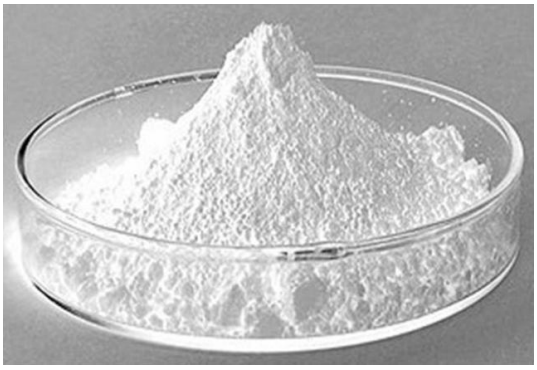
2.1 Objects of research

When researching the pharmaceutical market of drugs with calamine, the object was the existing range listed in the State Register of Medicinal Products of Ukraine [10, 12, 15, 23, 34, 35].

Calamine (BP 2009, p. 1-2)

An amorphous, impalpable, pink or reddish brown powder, the colour depending on the variety and amount of iron(III) oxide present and the process by which it is incorporated.

Practically insoluble in water. It dissolves with effervescence in hydrochloric acid.



Zinc oxide (SPU 1.1, p. 483)

Soft, white or faintly yellowish-white, amorphous powder, free from gritty particles.

Emulsifier Montanov 202 (Arachidyl Alcohol and Behenyl Alcohol and Arachidyl Glucoside)

Small granules from white to light beige color, product pH (5% solution): 6.3.

Emulsifier “Emulpharma 1000” (Cetearyl Glucoside, Sorbitan Stearate, Glyceryl Stearate, Cetearyl Alcohol)
Particles from white to cream color, pH blown (5% solution): 6.0 - 8.0. HLB 9.5.

Peach oil (SSTU 4492:2005)
Transparent yellowish viscous liquid with a weak specific smell.

Purified water (SPU 2.2, p. 129)
Transparent colorless liquid without color and odor.

All substances used met the requirements of the relevant regulatory documentation.

2.2 Methods of research

Organoleptic control

The analysis of the quality of the obtained emulsion was carried out in accordance with the requirements of the general article of SPU 2.0 “Semi-solid medicinal products for dermal application”.

Statistical analysis of the research results was carried out in accordance with the requirements of SPU 2.1, section 5.3 using methods of statistical and mathematical analysis [38-40].

Conclusions to chapter 2

1. The properties of the research objects are described, in particular active pharmaceutical ingredients (calamine and zinc oxide), which were used in the experimental part.

2. Methods and conditions for conducting organoleptic control and statistical analysis used in studying the quality of samples of calamine emulsion were selected and described.

CHAPTER 3

DEVELOPMENT OF THE COMPOSITION COSMETIC EMULSION WITH CALAMINE

3.1 Analysis of the domestic market of remedies with calamine

Currently Ukrainian pharmaceutical market [36] includes lotion with calamine with the same composition by 2 producers: Ben Shimon Floris Ltd. (Israel) and Arabona (Ukraine) (fig. 3.1).

a b

Fig. 3.1 Calamine lotion: a – by Ben Shimon Floris Ltd. (Israel), b – by Arabona (Ukraine)

Analysis of the propositions of this medicine on the website https://tabletki.ua/ showed that on May 2, 2023 there are only 29 pharmacies, where this medicine is available in Ukraine.

The price ranges from UAH 182.52 (Okhtyrka, Sumy Oblast) to UAH 334.50 (Odesa).

Fluctuations in the average price of calamine lotion during the previous year are shown in fig. 3.2.

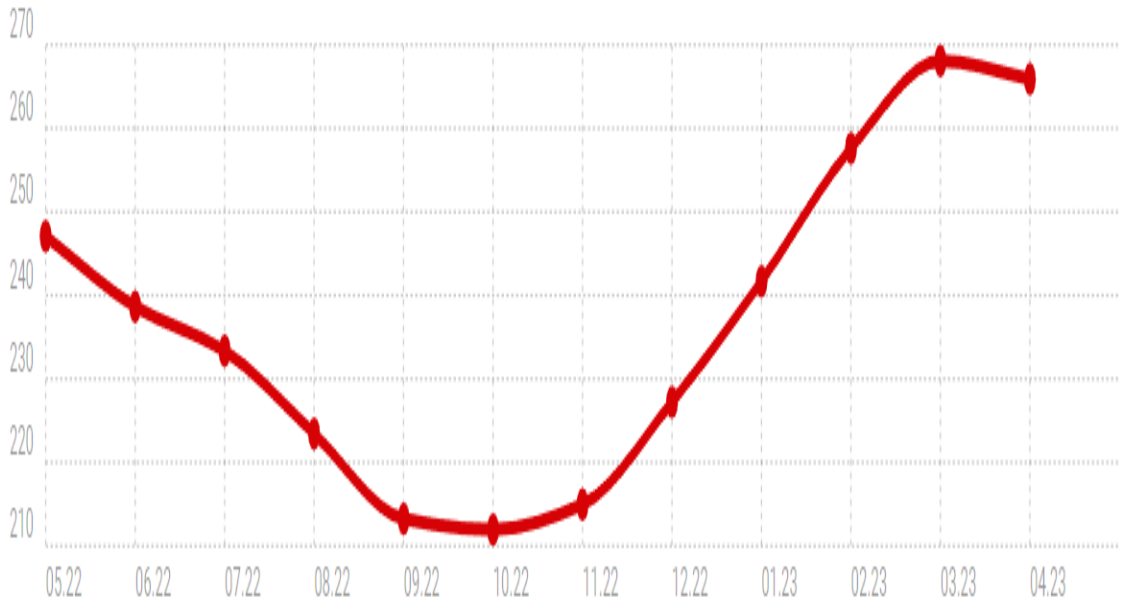


Fig. 3.2 Fluctuations in the average price of calamine lotion during the previous year

As can be seen from the above results, the development of a calamine-based product is relevant and timely.

3.2 Selection of active and auxiliary substances of calamine emulsion

At the first stage of work, we conducted studies on the choice of a rational emulsifier.

The state of the formed emulsion system was evaluated according to organoleptic indicators. The emulsion should be stable, have pleasant consumer characteristics and be easy to dose.

The percentage content of the ingredients was chosen based on the analysis of data from literary scientific sources of domestic and foreign researchers.

The composition of the studied emulsion samples is given in table 3.1.

Table 3.1

Research on the choice of emulsifier

Ingredients	Content, mass. %					
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
1	**2**	**3**	**4**	**5**	**6**	**7**
Peach oil	64,5	60,0	60,0	60,0	64,59	64,28
Purified water	35,0	35,0	35,0	35,0	35,0	35,0
Emulsifier Silk guar	0,5	-	-	-	-	-
Emulsifier Emulpharma	-	5,0	-	-	-	-
Emulsifier Planta M	-	-	5,0	-	-	-
Emulsifier Montanov 202	-	-	-	5,0	-	-
Emulsifier Macrogol-80	-	-	-	-	0,41	-
Emulsifier Macrogol-80	-	-	-	-	-	0,72

The study of samples of the formed emulsion showed the following:

Sample 1: The emulsion did not form and immediately separated.

Sample 2: Emulsion formed, does not delaminate over time, but it is too thin.

Sample 3: the emulsion has formed, does not delaminate over time, but the consistency is too thick.

Sample 4: The emulsion has formed, does not flake over time, the consistency is perfect for creating a restorative after tan.

Sample 5: emulsion formed, homogeneous, relatively liquid. Over time (5 minutes), it became layered.

Sample 6: emulsion formed, homogeneous, relatively liquid. Over time (10 minutes), it became layered.

It was experimentally established that:

• silk guar emulsifier is not suitable for forming the necessary emulsion (emulsion separated);

• the Emulpharma emulsifier is not suitable for the formation of the necessary emulsion (the emulsion is too liquid);

• Planta M emulsifier is not suitable for forming the necessary emulsion (emulsion is too dense);

• emulsifier twin-80 is not suitable for the formation of the necessary emulsion (the emulsion has separated, has a specific smell).

Therefore, according to organoleptic indicators, the best emulsifier for the formation of an emulsion base for a skin care lotion is Montanov 202 at a concentration of 5%.

The research of the variety of scientific literature showed that calamine is often combined with zinc oxide. Their combination effectively eliminates skin itching arising from various causes. For example, it stops the itching of postoperative stitches that are healing. It is also used for itchy insect bites, skin rashes with some diseases, etc.

API doses were established based on the analysis of literature sources and recommendations of dermatologists: 15-25 % for calamine and 5-15 % for zinc oxide.

The amount of active substances was determined according to already known doses given in literature sources.

The compositions of model samples of the calamine emulsion are given in table 3.3

The resulting composition of the calamine emulsion is given in table 3.2.

Table 3.2

Composition of model samples of the calamine emulsion

Ingredient	Sample 1	Sample 2	Sample 3
Calamine, %	15.0	20.0	25.0
Zinc oxide, %	5.0	10.0	15.0

The samples were prepared according to the rules for the preparation of emulsion systems [2, 37]: the emulsifier was melted, the oil phase was added;

purified water was heated separately to the same temperature, the phases were shifted using a laboratory homogenizer Daihan Homogenizer with Direct Controller HG-15A (Daihan Scientific, Korea) until a homogeneous emulsion system was formed. Calamine and zinc sulfate were administered as a suspension.

Samples 1 and 2 are white, homogeneous, with a specific smell. Sample 3 is pale pink in color, homogeneous, with a slight specific smell.

The condition of the obtained emulsion lotions was studied over time. It was found that samples 2 and 3 were homogeneous, but delamination of the emulsion samples took place over time. Sample 1 has the best organoleptic properties and a pleasant consistency, so it was this sample that we used for further research.

3.3 Description of technology of calamine emulsion

Based on the previous findings, the following composition of the calamine emulsion was developed (table 3.3).

Table 3.3

Composition of the calamine emulsion

Ingredient	Quantity, mass. %
Calamine, %	15.0
Zinc oxide, %	5.0
Peach oil	48.0
Purified water	28.0
Emulsifier Montanov 202	4.0
Total:	100.0

Technology of preparation of emulsion lotion with calamine:

• in a water bath (Δ t 60-65 °C) melt the Montanov 202 emulsifier in a porcelain cup No. 1, add peach oil, mix until smooth;

• Put purified water in a porcelain cup No. 2 and heat in a water bath (Δ t 60-65 °C);

• the aqueous phase is transferred into a porcelain cup to the oil phase and emulsified using a Daihan Homogenizer with Direct Controller HG-15A laboratory homogenizer (Daihan Scientific, Korea) until a homogeneous emulsion system is formed;

• put calamine and zinc oxide into the mortar and grind with the half amount of the ready emulsion by Deryagin's rule;

• add the rest of emulsion to the calamine and zinc oxide mixture and mix thoroughly until a homogeneous mass is formed;

• put the obtained calamine emulsion to the container.

The resulting calamine emulsion is pale pink, with a pleasant smell and light texture, quickly absorbed into the skin without leaving a sticky layer, which indicates proper consumer properties (Fig. 3.3).

Fig. 3.3 Calamine emulsion

Conclusions to chapter 3

1. Analysis of the range of the Ukrainian pharmaceutical market of calamine-based drugs showed that only 2 products in the form of a suspension lotion are currently presented. Only 29 pharmacies from the whole country have these products. The price ranges from UAH 182.52 (Okhtyrka, Sumy Oblast) to UAH 334.50 (Odesa).

2. Studies of the state of emulsion systems based on 5 emulsifiers (silk guar, Emulpharma 1000, Montanov 202, Planta M, macrogol-80) proved that the best emulsifier for the formation of an emulsion base for an emulsion with calamine is Montanov 202 at a concentration of 5%.

3. On the basis of the selected API calamine and zinc oxide, 3 formulations of emulsions were developed. The condition of the obtained emulsions was studied over time. It was found that samples 2 and 3 were homogeneous, but the emulsion was delaminated over time. Sample 1 has the best organoleptic properties and a pleasant consistency, so it was this sample that we used for further research.

4. A rational laboratory production technology is described for the emulsion of the developed composition.

GENERAL CONCLUSIONS

1. Calamine as an active pharmaceutical ingredient is characterized. In particular, its physical and chemical properties and areas of use in medical, pharmaceutical and cosmetic practice are described.

2. Data from literary sources on the theoretical foundations of the production of cosmetic emulsions were analyzed.

3. The properties of the research objects, in particular, active pharmaceutical ingredients (calamine, zinc oxide) and auxiliary substances (purified water, peach oil, emulsifiers Montanov 202, Emulpharma 1000) used in the experimental part are described. The methods and conditions of conducting organoleptic and statistical methods of analysis, which were used during the experimental part, are described.

4. A study of the assortment of the Ukrainian pharmaceutical market of calamine-based drugs showed that only 2 products in the form of a suspension lotion are currently presented. Only 29 pharmacies from the whole country have these products. The price ranges from UAH 182.52 (Okhtyrka, Sumy Oblast) to UAH 334.50 (Odesa).

5. During experimental research, 6 samples of emulsion systems based on 5 emulsifiers (silk guar, Emulpharma, Montanov 202, Planta M, twin-80) were studied. It has been established that the best emulsifier for the formation of an emulsion base for a preparation with calamine is Montanov 202 at a concentration of 5%.

6. Research of 3 emulsion compositions based on selected APIs (calamine, zinc oxide) showed that sample No. 1 has the best organoleptic properties and a pleasant consistency. The laboratory manufacturing technology for the developed emulsion with calamine is described.

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Appendixes

МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ

СЕРТИФІКАТ УЧАСНИКА

Цим засвідчується, що

Inouz Nizar

Scientific supervisor: Semchenko K.V.

брав(ла) участь у роботі

XXIX Міжнародної науково-практичної конференції молодих вчених та студентів

«АКТУАЛЬНІ ПИТАННЯ СТВОРЕННЯ НОВИХ ЛІКАРСЬКИХ ЗАСОБІВ»

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МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ Національний фармацевтичний університет № 02010936

Алла КОТВІЦЬКА

19-21 квітня 2023 р, м. Харків

Appendix B

МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ

АКТУАЛЬНІ ПИТАННЯ СТВОРЕННЯ НОВИХ ЛІКАРСЬКИХ ЗАСОБІВ

МАТЕРІАЛИ
XXIX МІЖНАРОДНОЇ НАУКОВО-ПРАКТИЧНОЇ
КОНФЕРЕНЦІЇ МОЛОДИХ ВЧЕНИХ ТА СТУДЕНТІВ

19-21 квітня 2023 року
м. Харків

Харків
НФаУ
2023

Appendix B

УДК 615.1

Редакційна колегія: проф. Котвіцька А. А., проф. Владимирова І. М.
Укладачі: Сурікова І. О., Боднар Л. А., Григорів Г. В. Литкін Д. В.

Актуальні питання створення нових лікарських засобів: матеріали XXIX міжнародної науково-практичної конференції молодих вчених та студентів (19-21 квітня 2023 р., м. Харків). – Харків: НФаУ, 2023. – 606 с.

Збірка містить матеріали Всеукраїнської науково-практичної конференції «Youth Pharmacy Science», які представлені за пріоритетними напрямами науково-дослідної роботи Національного фармацевтичного університету. Розглянуто теоретичні та практичні аспекти синтезу біологічно активних сполук і створення на їх основі лікарських субстанцій; стандартизації ліків, фармацевтичного та хіміко-технологічного аналізу; вивчення рослинної сировини та створення фітопрепаратів; сучасної технології ліків та екстемпоральної рецептури; біотехнології у фармації; досягнень сучасної фармацевтичної мікробіології та імунології; доклінічних досліджень нових лікарських засобів; фармацевтичної опіки рецептурних та безрецептурних лікарських препаратів; доказової медицини; сучасної фармакотерапії, соціально-економічних досліджень у фармації, маркетингового менеджменту та фармакоекономіки на етапах створення, реалізації та використання лікарських засобів; управління якістю у галузі створення, виробництва й обігу лікарських засобів; суспільствознавства; фундаментальних та мовних наук.

УДК 615.1

Appendix B

XXIX Міжнародна науково-практична конференція молодих вчених та студентів
«АКТУАЛЬНІ ПИТАННЯ СТВОРЕННЯ НОВИХ ЛІКАРСЬКИХ ЗАСОБІВ»

STUDY OF TECHNOLOGICAL ASPECTS OF CALAMINE INTRODUCTION INTO EMULSION SYSTEM

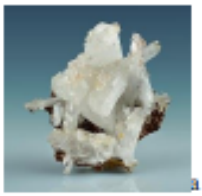
Inouz Nizar
Scientific supervisor: Semchenko K.V.
National University of Pharmacy, Kharkiv, Ukraine
tolochko.kv@gmail.com

Introduction. Calamine is intended for the complex treatment of various dermatological diseases, including infectious ones. It is frequently introduced in the composition of remedies, which are used externally, effectively eliminating skin itching arising from various causes. It is also used for itchy insect bites, skin rashes with some diseases, etc.

Aim. The aim of out research is to specify physico-chemical and pharmacotechnological properties of calamine, which are important to justify the technological aspects of API's introduction into emulsion system for the further extemporaneous production.

Materials and methods. The work uses methods of analysis and generalization of scientific literature data.

Results and discussion. The mineral calamine ($Zn_4(OH)_2[Si_2O_7]xH_2O$, fig. 1) occurs as small crystals that grow densely on the walls of cracks and form druses. Often there are sintered forms with a concentric-shellish structure, in which rays of elongated needle-shaped or lamellar individuals can be clearly distinguished.


a

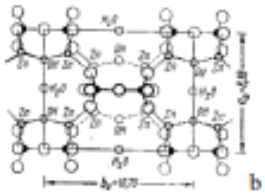

b

Fig. 1. Calamine: a – mineral form hemimorphite, b – crystal structure

Its physical properties: calamine is usually colorless, but sometimes, due to impurities, it turns grayish, yellow, brown, and less often green and blue. Glass luster. Cleavage perfect according to (110). Hardness – 4-5. Density – 3.4-3.5. When heated, the upper and lower ends of the crystals are charged with opposite charges of electricity. Optical properties: biaxial, positive; ng = 1.636, nm = 1.617, np = 1.614, ng – np = 0.022; 2V = 46°.

Calamine does not dissolve neither in water nor in oils.

Conclusions. on the basis of the obtained results it can be concluded that calamine can be introduced in the emulsion system only by the type of suspension due to the issues of its solubility.

USE OF CRATAEGUS PLANT RAW MATERIALS IN THE DEVELOPMENT OF HOMEOPATHIC PREPARATIONS

Majdoubi Adnane, Oliinyk S.V., Yarnykh T.G., Pul-Luzan V.V.
National University of Pharmacy, Kharkiv, Ukraine
tl@nuph.edu.ua

Introduction. The main feature of medicinal products, which distinguishes them from any other type of substances or products, is that they are intended for the treatment and assistance of a

Appendix C

МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ
РАДА МОЛОДИХ ВЧЕНИХ ПРИ ХАРКІВСЬКІЙ ОБЛАСНІЙ ВІЙСЬКОВІЙ АДМІНІСТРАЦІЇ
РАДА МОЛОДИХ ВЧЕНИХ
СТУДЕНТСЬКЕ НАУКОВЕ ТОВАРИСТВО

ПРОГРАМА

XXIX Міжнародної науково-практичної конференції молодих вчених та студентів «АКТУАЛЬНІ ПИТАННЯ СТВОРЕННЯ НОВИХ ЛІКАРСЬКИХ ЗАСОБІВ»

19-21 квітня 2023 р.

Харків – 2023

Appendix C

Кафедра аптечної технології ліків

1. **Порівняльний аналіз складу рідких засобів для лікування акне на основі кліндаміцину промислового та екстемпорального виробництва**
   Доповідач: Кметик Юлія
   Науковий керівник: Семченко К. В., докт. фарм. н., доцент
2. **Аналіз аптечного виробництва капсул в Німеччині**
   Доповідач: Соляник Кристина
   Науковий керівник: Вишневська Л. І., докт. фарм. н., професор
3. **Розробка складу, технології та дослідження бальзаму–маски аплікаційного нанесення для лікування себорейного дерматиту шкіри голови**
   Доповідач: Черкасова Альбіна
   Науковий керівник: Коноваленко І. С., докт. філ., асистент
4. **About the prospects of using medicines based on peptides and their compositions**
   Доповідач: Мороз Ксенія
   Науковий керівник: Ковальова Т. М., к. фарм. н., доцент
5. **Research of raw materials of nightshade for use in pharmacy practice**
   Доповідач: Кочнєва Поліна
   Науковий керівник: Вишневська Л. І., докт. фарм. н., професор
6. **Опрацювання складу гелю для ясен**
   Доповідач: Ладогубець Дмитро
   Науковий керівник: Половко Н. П., докт. фарм. н., професор
7. **Розробка складу та технології багатокомпонентного анальгетика**
   Доповідач: Варуша Анна
   Науковий керівник: Марченко М. В., к. фарм. н., доцент
8. **Розробка складу та технології препарату адаптогенної дії**
   Доповідач: Ткаченко Влада
   Науковий керівник: Марченко М. В., к. фарм. н., доцент
9. **Development of the composition and technology of antiemetic capsules**
   Доповідач: Галайда Юлія
   Науковий керівник: Коноваленко І. С., докт. філ., асистент

Appendix C

20. **Development of topical gel analgesic activities**
Доповідач: Бендіжур Іман
Науковий керівник: Крюкова А. І., к. фарм. н., асистент

21. **Development of the composition of antibacterial soap with a complex of essential oils**
Доповідач: Ель Амрані Худа
Науковий керівник: Семченко К. В., докт. фарм. н., доцент

22. **Development of the composition of emulsion with calamine of pharmaceutical production**
Доповідач: Інуз Нізар
Науковий керівник: Семченко К. В., докт. фарм. н., доцент

23. **Development of the composition of a vitamin medicine in the form of an effervescent powder**
Доповідач: Секкум Фатіма Захра
Науковий керівник: Семченко К. В., докт. фарм. н., доцент

24. **Use of vegetable oil in extemporaneous formulation**
Доповідач: Джаафар Хамза
Науковий керівник: Вишневська Л. І., докт. фарм. н., професор

25. **Research on the development of an ointment base using pharmaceutical factors**
Доповідач: Тазані Шаймае
Науковий керівник: Вишневська Л. І., докт. фарм. н., професор

26. **Research on substantiation of the technology of mahonia extract berries**
Доповідач: Мауелаінін Мохамед Фадель
Науковий керівник: Половко Н. П., докт. фарм. н., професор

27. **Justification of the composition of the medication for local anesthesia in the form of a cream**
Доповідач: Наіт Іжжа Хансаа
Науковий керівник: Половко Н. П., докт. фарм. н., професор

28. **Development of the composition and technology of the antifungal foot spray**
Доповідач: Харафі Ахмед
Науковий керівник: Половко Н. П., докт. фарм. н., професор

29. **Research on the substantiation of the technology of the dry herb extract of black peppermint**
Доповідач: Укхбуроу Мохамед
Науковий керівник: Марченко М. В., к. фарм. н., доцент

National University of Pharmacy

Faculty for foreign citizens' education
Department pharmaceutical technology of drugs

Level of higher education master

Specialty 226 Pharmacy, industrial pharmacy
Educational program Pharmacy

APPROVED
The Head of
pharmaceutical
technology of drugs
Department

Liliia VYSHNEVSKA
"_28_" _September_ 2022

ASSIGNMENT
FOR QUALIFICATION WORK
OF AN APPLICANT FOR HIGHER EDUCATION

Nizar INOUZ

1. Topic of qualification work: «Development of the composition of emulsion with calamine of pharmaceutical production», supervisor of qualification work: Kateryna SEMCHENKO, Doctor of Pharmacy, assoc. prof.

approved by order of NUPh from "6st" of February 2023 № 35

2. Deadline for submission of qualification work by the applicant for higher education: April 2023.

3. Outgoing data for qualification work: the work is devoted to the development the composition of cosmetic emulsion based on calamine of pharmaceutical production

4. Contents of the settlement and explanatory note (list of questions that need to be developed): •
- conduct a biblio-semantic analysis of literary data regarding the characteristics of calamine;
- conduct an analysis of the range of medicines that contain calamine;
- develop the composition of emulsion, which contains calamine, and zinc oxide;
- justify the technology of emulsion, which contains calamine, and zinc oxide.

5. List of graphic material (with exact indication of the required drawings):
Tables – 3, figures – 10

6. Consultants of chapters of qualification work

Chapters	Name, SURNAME, position of consultant	Signature, date	
		assignment was issued	assignment was received
1	Kateryna SEMCHENKO, associate professor of higher education institution of pharmaceutical technology of drugs department	28.09.2022	28.09.2022
2	Kateryna SEMCHENKO, associate professor of higher education institution of pharmaceutical technology of drugs department	17.11.2022	17.11.2022
3	Kateryna SEMCHENKO, associate professor of higher education institution of pharmaceutical technology of drugs department	19.12.2022	19.12.2022

7. Date of issue of the assignment: «28» September 2022

CALENDAR PLAN

№ з/п	Name of stages of qualification work	Deadline for the stages of qualification work	Notes
1	Topic selection	September 2022	**done**
2	Literature data analysis	October 2022	**done**
3	Conducting experimental research	October-December 2022	**done**
4	Work design	January-March 2023	**done**
5	Submission of finished work to the commission	April 2023	**done**

An applicant of higher education _____ Nizar INOUZ

Supervisor of qualification work _____ Kateryna SEMCHENKO

ВИТЯГ З НАКАЗУ № 35
По Національному фармацевтичному університету
від 06 лютого 2023 року

нижченаведеним студентам 5-го курсу 2022-2023 навчального року, навчання за освітнім ступенем «магістр», галузь знань 22 охорона здоров'я, спеціальності 226 – фармація, промислова фармація, освітня програма – фармація, денна форма здобуття освіти (термін навчання 4 роки 10 місяців та 3 роки 10 місяців), які навчаються за контрактом, затвердити теми кваліфікаційних робіт:

Прізвище студента	Тема кваліфікаційної роботи		Посада, прізвище та ініціали керівника	Рецензент кваліфікаційної роботи
• **по кафедрі аптечної технології ліків**				
Інуз Нізар	Розробка складу емульсії з каламіном аптечного виробництва	Development of the composition of emulsion with calamine of pharmaceutical production	доц. Семченко К. В.	проф. Ковалевська І. В.

Підстава: подання декана, згода ректора

Ректор

Вірно. Секретар

Ф А2.8-47-110

ВИСНОВОК

Комісії з академічної доброчесності про проведену експертизу щодо академічного плагіату у кваліфікаційній роботі здобувача вищої освіти

№ 112909 від « 2 » травня 2023 р.

Проаналізувавши випускну кваліфікаційну роботу за магістерським рівнем здобувача вищої освіти денної форми навчання Інуз Нізар, Фм18(5,0)
5 курсу, англ-08 групи, спеціальності 226 Фармація, промислова фармація, на тему: «Розробка складу емульсії з каламіном аптечного виробництва / Development of the composition of emulsion with calamine of pharmaceutical production», Комісія з академічної доброчесності дійшла висновку, що робота, представлена до Екзаменаційної комісії для захисту, виконана самостійно і не містить елементів академічного плагіату (компіляції).

Голова комісії,
професор **Інна ВЛАДИМИРОВА**

3%

26%

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

Nizar INOUZ

on the topic: «Development of the composition of emulsion with calamine of pharmaceutical production»

Relevance of the topic.

Currently the pharmaceutical market of Ukraine lacks medicines with calamine as there are only 29 pharmacies (according to May 2023 research) where such medicines can be found. Therefore, the development of the medicine with calamine in the dosage form of emulsion is an actual and up-to-date direction of pharmaceutical studies.

Practical value of conclusions, recommendations and their validity.

The practical value of the work is based on the study of physical and chemical, pharmaco-technological, economical and statistical studies of calamine and samples of cosmetic emulsion obtained on their basis. The research of the pharmaceutical market of Ukraine showed that currently there are only 2 medicines with calamine in the dosage form of emulsion. The author successfully justified the composition and technology of cosmetic emulsion with calamine and introducing zinc oxide to increase the medicinal activity of the obtained cosmetic emulsion.

Assessment of work.

The successful solution of tasks enabled the author of the qualification work to achieve the goal and obtain practical and theoretical results. The work was done at a sufficient scientific level, which indicates the author’s ability to work with literary sources, analyze, systematize and generalize the experimental data obtained.

General conclusion and recommendations on admission to defend.

The qualification work of Nizar INOUZ meets all the requirements for qualification works and can be presented for the defense at the Examination Commission of the National University of Pharmacy.

Scientific supervisor _____ Kateryna SEMCHENKO

«12» April 2023

Ф А 2.2.1-32-356

REVIEW

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

Nizar INOUZ

on the topic: «Development of the composition of emulsion with calamine of pharmaceutical production»

Relevance of the topic.

Medicines based on calamine show a high dermatological effect: they cool, disinfect and relieve inflammation. One of their main properties is the formation of an effective protective barrier on the surface of the skin. Thanks to all this, the affected area quickly recovers.

Calamine remedies have a calming effect, quickly eliminates the symptoms of itching, inflammation, prevents the development of the pathological process, promotes the activation of the skin regeneration process.

Theoretical level of work.

The applicant for higher education conducted analysis of modern scientific literature concerning physical and chemical properties of calamine and the theoretical basis of emulsion formation. The author conducted the analysis of Ukrainian pharmaceutical market of remedies with calamine and proved the relevance of the development of new extemporal medicines based on calamine.The experimental part included justification of composition of cosmetic emulsion with calamine and zinc oxide.

The author’s suggestions on the topic of research.

It was determined that it is advisable to introduce zinc oxide to synergize the effect of calamine. Technology of basic emulsion was described. The laboratory technology of suspension type introduction of APIs into the basic emulsion is justified and described.

Practical value of conclusions, recommendations and their validity.

A medicinal and cosmetic product with cool, disinfect and relieve effect based on a complex of calamine and zinc oxide is offered.

Disadvantages of work.

There are incorrect expressions and grammatical errors in the work.

General conclusion and assessment of the work.

The qualification work of Nizar INOUZ based on the results of research and volume of the experiment performed can be presented for the defense at the Examination Commission of the National University of Pharmacy.

Reviewer _____ prof. Inna KOVALEVSKA

«19» April 2023

МІНІСТЕРСТВО ОХОРОНИ ЗДОРОВ'Я УКРАЇНИ
НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ

ВИТЯГ З ПРОТОКОЛУ № _9_
«26» квітня 2023 року
м. Харків

засідання кафедри
___ *аптечної технології ліків* _____
(назва кафедри)

Голова: завідувачка кафедри, професор Вишневська Л.І.
Секретар: докт. філ., асистент Коноваленко І. С.

ПРИСУТНІ:

Богуцька О. Є., Зуйкіна С. С., Ковальова Т. М., Крюкова А. І., Марченко М. В., Половко Н. П., Семченко К. В.

ПОРЯДОК ДЕННИЙ:

1. Про представлення до захисту кваліфікаційних робіт здобувачів вищої освіти.

СЛУХАЛИ: проф. Вишневську Л. І. – про представлення до захисту до Екзаменаційної комісії кваліфікаційних робіт здобувачів вищої освіти.

ВИСТУПИЛИ: Здобувач вищої освіти групи Фм18(5,0д)-англ 08 спеціальності 226 Фармація, промислова фармація Нізар ІНУЗ – з доповіддю на тему «Розробка складу емульсії з каламіном аптечного виробництва / Development of the composition of emulsion with calamine of pharmaceutical production» (науковий керівник доц. Катерина СЕМЧЕНКО).

УХВАЛИЛИ: Рекомендувати до захисту кваліфікаційну роботу.

Голова
Завідувачка кафедри, проф. _____ **Лілія ВИШНЕВСЬКА**
(підпис)

Секретар
асистент _____ **Ілона КОНОВАЛЕНКО**
(підпис)

Ф А2.2.1-32-042

НАЦІОНАЛЬНИЙ ФАРМАЦЕВТИЧНИЙ УНІВЕРСИТЕТ

ПОДАННЯ
ГОЛОВІ ЕКЗАМЕНАЦІЙНОЇ КОМІСІЇ
ЩОДО ЗАХИСТУ КВАЛІФІКАЦІЙНОЇ РОБОТИ

Направляється здобувач вищої освіти Нізар ІНУЗ до захисту кваліфікаційної роботи за галуззю знань 22 Охорона здоров'я
спеціальністю 226 Фармація, промислова фармація
освітньою програмою Фармація
на тему: «Розробка складу емульсії з каламіном аптечного виробництва»

Кваліфікаційна робота і рецензія додаються.

Декан факультету _____ / Світлана КАЛАЙЧЕВА /

Висновок керівника кваліфікаційної роботи

Здобувач вищої освіти Нізар ІНУЗ представила кваліфікаційну роботу, яка за об'ємом теоретичних і практичних досліджень повністю відповідає вимогам до оформлення кваліфікаційних робіт.

Керівник кваліфікаційної роботи

_____ Катерина СЕМЧЕНКО

«12» квітня 2023 р.

Висновок кафедри про кваліфікаційну роботу

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

Завідувачка кафедри
аптечної технології ліків

_____ Лілія ВИШНЕВСЬКА

«26» квітня 2023 року

Qualification work was defended

of Examination commission on

« » June 2023

With the grade _____

Head of the State Examination commission,

D Pharm Sc, Professor

_____ / Oleh SHPYCHAK /