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Microemulsions based on vegetable oils for medical applications

Abstract

Relevance of the work

Much attention in modern pharmaceuticals is paid to the development of new carriers for the delivery of biologically active substances, which can increase the efficiency of delivery, reduce the side effects of drugs and optimize production costs. Nanostructured materials based on substances of natural origin are being actively studied for targeted delivery of drugs. Self-organizing nanostructures such as microemulsions of lecithin, a surfactant of natural origin, the main lipid component of biological membranes, can serve as a carrier for transdermal delivery of drugs. The advantages of microemulsions as self-organizing nanostructures are simple production methods and reproducibility of properties.

It is known that in ternary systems lecithin – oil – water, reverse micelles exist, but microemulsions are not formed. To obtain lecithin microemulsions intended for medicine and cosmetics, it is necessary to introduce non-toxic, biocompatible accompanying surfactants (cosurfactants) and oils. Previously, oleic acid was proposed as a cosurfactant for the production of lecithin microemulsions; microemulsions in the system lecithin – oleic acid – vaseline oil – avocado oil – tea tree essential oil – water were studied. Edible vegetable oils can be used to obtain lecithin microemulsions; their advantages are safety and low cost. Lecithin microemulsions based on edible vegetable oils will have great potential applications not only in medicine, but also in areas such as cosmetics or food.

Purpose and objectives

The purpose of this work is to study microemulsions in the systems lecithin – oleic acid – vaseline oil – vegetable oil – essential oil – water.

To achieve this purpose, the following **objectives** were proposed.

1. Development of the composition and study of the properties of microemulsions containing turmeric essential oil and gac vegetable oil.
2. Study of the properties of microemulsions containing turmeric essential oil in combination with vegetable oils: soybean, coconut, olive or sunflower.
3. Development of a technique for producing microemulsions with vegetable oils on a laboratory scale.

Scientific novelty

1. A new microemulsion system of lecithin – oleic acid – vaseline oil – oil from the tropical plant gac (*Momordica cochinchinensis*) – essential oil of turmeric (*Curcuma longa*) – water was obtained and studied. The region of existence of the microemulsion was determined at a molar concentration ratio of $C_{oleic\ acid}/C_{lecithin}$ = 0.6 and a mass ratio of vaseline oil : gac oil equal to 1:1. The hydrodynamic diameter of droplets of reverse microemulsions with gac oil depends linearly on the parameter W (molar ratio of water and lecithin); it varies in the range from 3 to

21 nm. Using Fourier transform infrared spectroscopy, it was shown that the studied microemulsion contains both hydrate (associated with the polar groups of the surfactant) and bulk (free) water.

2. It has been shown that for microemulsions with vegetable oils of gac, soybean and olive, the maximum solubilization capacity for water is achieved at a ratio of $C_{oleic\ acid}/C_{lecithin}$ = 0.4 - 0.6; for microemulsions with coconut and sunflower oils, its value practically does not depend on the $C_{oleic\ acid}/C_{lecithin}$ ratio. The region of existence of microemulsion with vegetable oils was determined at $C_{oleic\ acid}/C_{lecithin}$ = 0.6; the maximum water content in microemulsions is achieved at a concentration of a mixture of lecithin and oleic acid of 40 - 60%; for the oils it is: gac - 13%, soybean - 11%, olive - 9%, coconut - 5%, sunflower - 4%.

3. A comparison of the properties of vegetable oils and the properties of microemulsions obtained on their basis showed that the hydrodynamic diameter of droplets of microemulsions, their viscosity and the rate of release of water-soluble dye slightly depend on the type of oil, while the widest range of existence by water was for the microemulsions based on vegetable oils with the most uniform distribution of saturated, monounsaturated and polyunsaturated fatty acid residues in the composition of triglycerides.

Practical value

1. It has been shown that to obtain reverse microemulsions in systems lecithin - oleic acid - vaseline oil - vegetable oil - essential oil - water, intended for use in medicine and cosmetics, you can use oil from the tropical plant gac (*Momordica cochinchinensis*) and turmeric essential oil (*Curcuma longa*).

2. The compositions of microemulsions in the systems lecithin - oleic acid - vaseline oil - vegetable oil - turmeric essential oil - water, containing vegetable oils: gac, soybean, coconut, olive and sunflower, suitable for use in medicine and cosmetics, have been determined.

3. It has been shown that the proposed microemulsions have a low rate of release of water-soluble substances: for microemulsions containing 2.5 wt.% water, approximately 3% of Rhodamine C was released into the physiological solution in 6 hours of dialysis. This allows the creation of drugs with prolonged action on their basis.

4. A method for producing microemulsions of lecithin with vegetable oils on a laboratory scale has been developed. The technique involves the use of a reactor with a paddle stirrer and heating; in the future it can be easily scaled up.

Key points for the thesis presentation

1. Composition and properties of a new microemulsion containing lecithin, oleic acid, vaseline oil, gac vegetable oil, turmeric essential oil and water.

2. Comparison of the properties of lecithin microemulsions containing turmeric essential oil and vegetable oils: gac, soybean, coconut, olive and sunflower oil.

3. Method for producing microemulsions of lecithin with edible vegetable oils on a laboratory scale.