Development of a technology for obtaining a hydrogel dressings containing limonidin

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Recently, hydrogels, used in medicine, became the object of attention of scientists due to its unique properties, i.e. their compatibility with body fluids and organs. Such systems are used to produce dressings armbands, contact lenses, drug delivery systems.

Peculiar dosage forms are wound dressings (WD). The use of WD allows to significantly improving the treatment of burns, wounds and burns [1, 2]. It is currently used more than 300 kinds of wound dressings in clinical practice [3].

In Kazakhstan, despite the presence of rich natural resources, polymeric hydrogels are not produced, and the need for them medicine, cosmetics, chemical and pharmaceutical industries partly reduced by imports. At the same time, hydrogel dressings have many advantages over traditional fat and oil-based bases, in particular, provide an active cleansing wounds due to the draining effect, compatibility with a variety of drugs, their more complete and uniform release, prolonged action, which provides a high therapeutic effect.

However, almost all known industrially produced hydrogel dressings not contain drugs, which often limit the effectiveness of their use. This paper deals with the development of technology for producing such wound dressings based on hydrogel dressings containing the drug. As the drug synthetic local anesthetic Limonidin, for use in medical practice for the treatment of large wounds and burns was taken.

Earlier, at the department of chemistry and technology of organic matters, natural compounds and polymers has been developed recipe obtain hydrogel dressings containing Limonidin.

As the initial reaction mixture (IRM) for the polymer matrix was used an aqueous solution containing gel-forming polymer polyvinyl pyrrolidone (PVP), agar-agar, polyethylene glycol. For preparation of polymer matrix with optimal properties were varied the following parameters:

- 7 wt. % of PVP in the initial reaction mixture;
- 2 wt. % of agar-agar in the IRM;
- Radiation dose (25 to 75 kHz);
- 0.5 to 2 wt. % of medical substances.

One of the main functions of wound dressings - wound protection against the penetration of pathogenic microorganisms in the environment. Traditional cotton- gauze bandage provides a robust mechanical protection, but by absorbing wound discharge, it becomes a breeding ground for the development of pathogenic organisms. The majority of the currently available products can

be classified as low adherent dressings, semipermeable films, hydrocolloids, hydrogels, alginates, foam dressings or antimicrobial dressings [4].

One of the methods of synthesis and modification of hydrogels is the use of high energy radiation, particularly gamma radiation.

The obvious advantage of the method of radiation synthesis of hydrogels over traditional methods is the high purity of the products wherein the presence of chemical initiators is not required. Sample preparation not requires special sterile production areas that still allow to obtain a sterile product; irradiation process is easy to control. The synthesis of new polymers, modifying the surface or volumetric commercial products may be made with the added advantage of competitive (simultaneous) sterilization, which is necessary when using the product obtained as a medicament.

Particular interest the production of environmentally friendly dressings attracts researchers, that is, the use of lower doses of radiation gamma-rays.

In connection with the above, in this work we have proposed an alternative method of preparation. In contrast to the above-described method we proposed is the introduction of the drug through the nonwoven material in the polymer matrix, is already exposed. When you try to prepare dressings containing Limonidin the above method of crosslinking the polymer base does not occur. Since Limnodin phytopreparation is insoluble in water but dissolves in a mixture of alcohol: water (1:1). However, the alcohol molecules prevent radiation crosslinking of the polymer matrix due to the absorption of alcohol molecules electron beams. The resulting polymer matrix is formed is not crosslinked and does not form a gel.

The proposed process scheme comprises the following steps:

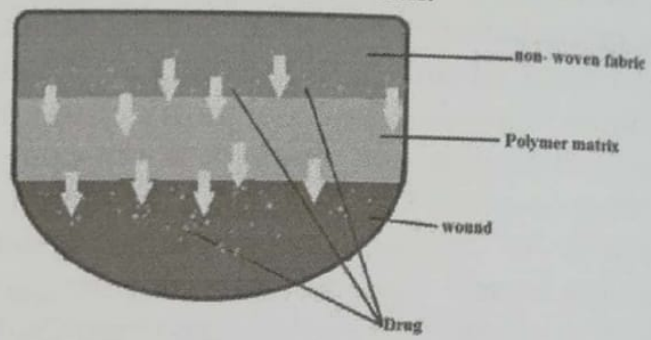
1. Preparation of PVP, agar-agar, Limonidin solutions;
2. Mixing of solutions;
3. Formations of dressings;
4. Radiation;
5. Impregnation of polymer matrix through non-woven fabric;
6. Packing of the wound dressings.

The proposed method has several advantages: medicinal substances are not degraded, because they are not exposed to radiation, economy of the energy, also radiation of blank polymer matrix is easier than with the Limonidin.

It should also be noted decrease of gamma ray emission to the atmosphere due to the lower dose of radiation, also the crosslink density decreases, which leads to better Limonidin desorption.

Thus, obtained hydrogel dressing has the following structure (picture 1). First - textile base. It is a material with a specially designed original structure, prevents the constituent fibers in the wound. This material not only provides breathability wound dressing, drainage properties, lightness, good adhesion to the wound, but also is a carrier of the second layer - the polymer.

The polymer layer comprises polyvinylpyrrolidone, agar and input thereto drug. Agar –agar produced by obtaining the extract are red and brown algae, which are found in the White Sea and the Pacific Ocean.



Pic. 1. Napkin has three functional layers formed during the process of producing the material

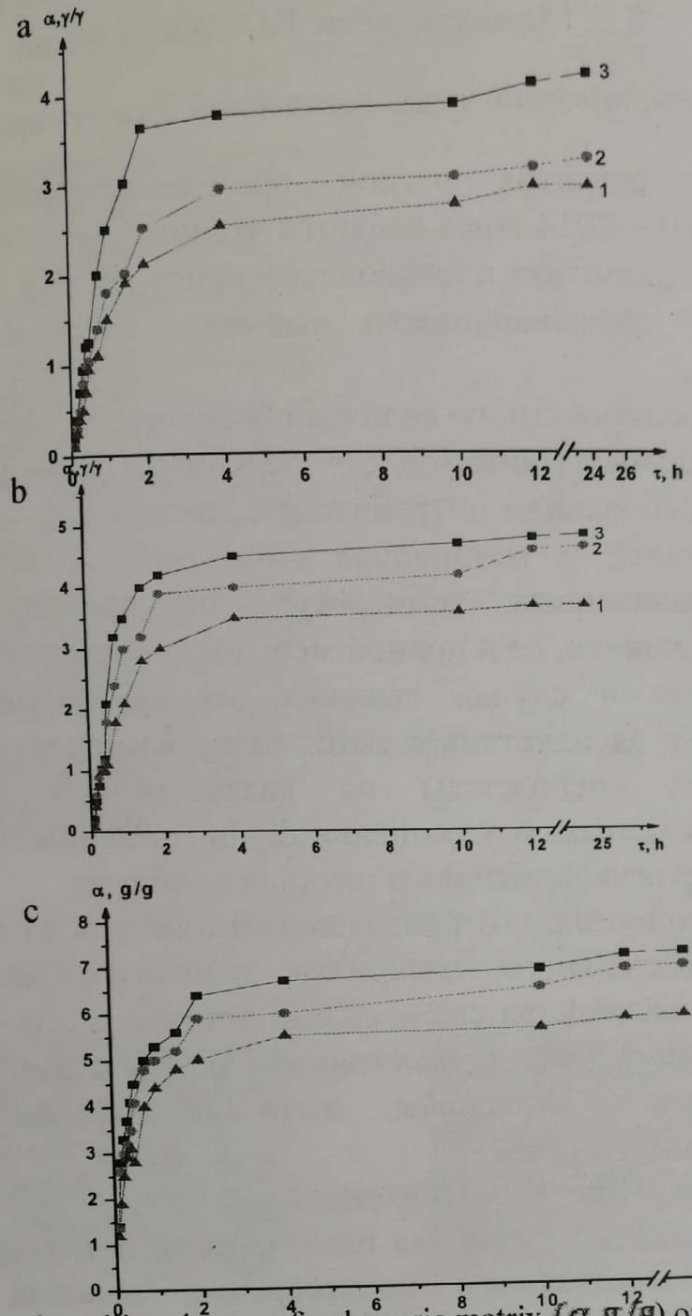
Swelling under the action of wound or liquid used to wet wipes, agar-agar gels, soft layer which is located between the textile backing and the wound, and provides atraumatic material makes the dressing less painful. The gel promotes cell migration, wound separation evacuates bacteria, perfectly cleans the wound.

As a drug used wound healing fitodrug limonidin derived from plants *Limonium gmelinii* growing in Kazakhstan and has anesthetic, wound healing action.

As it is known from the literature in healthy individuals the pH of the skin is slightly acidic (pH = 5,4 ± 0,09). Patients with pH supportive diseases of soft tissues in the wound is shifted toward slightly alkaline (pH = 6,76 ± 0,11). As healing at the end of the third phase the pH approaches the intact skin. Shifting the pH to the alkaline side of wounds in all phases of wound healing is a sign of unfavorable course. We have been to study the effect of pH on the degree of swelling in the present work. As shown by the data presented at picture 2 for values of α 4 and pH 7 do not differ greatly, but when the pH 9 degree of swelling of hydrogel dressings have a higher value. This fact confirms the effectiveness of the use of the obtained dressings in the treatment of wounds and burns. The degree of swelling of indicators suggest a possible a better absorption of wound exudate emitted. An important characteristic of the resulting polymer material is the absorption kinetics of the drug through the matrix of the nonwoven fabric. To conduct this analysis was used a gravimetric method which is as follows.

Thus, in the present study, was proposed alternative method for obtaining hydrogel dressings consisting of a polymeric matrix comprising a PVP, agar-agar, PEG and local origin fito preparation - Limonidin.

Feature of which is the introduction of the drug through the non-woven fabric on pre-irradiated matrix. The structure obtained bandages, consisting of three layers. Studied the basic physical and chemical parameters. It has been found that the degree of swelling of the drug and the yield depends on the degree of crosslinking of the polymer matrix.



Pic. 2. Dependence of swelling degree of polymeric matrix (α, g/g) on pH of the medium: 7 wt.% of HWD in the IRM, 2 wt.%; Agar-agar, D = dose of 40 kGy
[drug] = 0,5 (1); 1 (2); 2 wt.% (3); pH = 4 (a);7(b);9 (c)

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