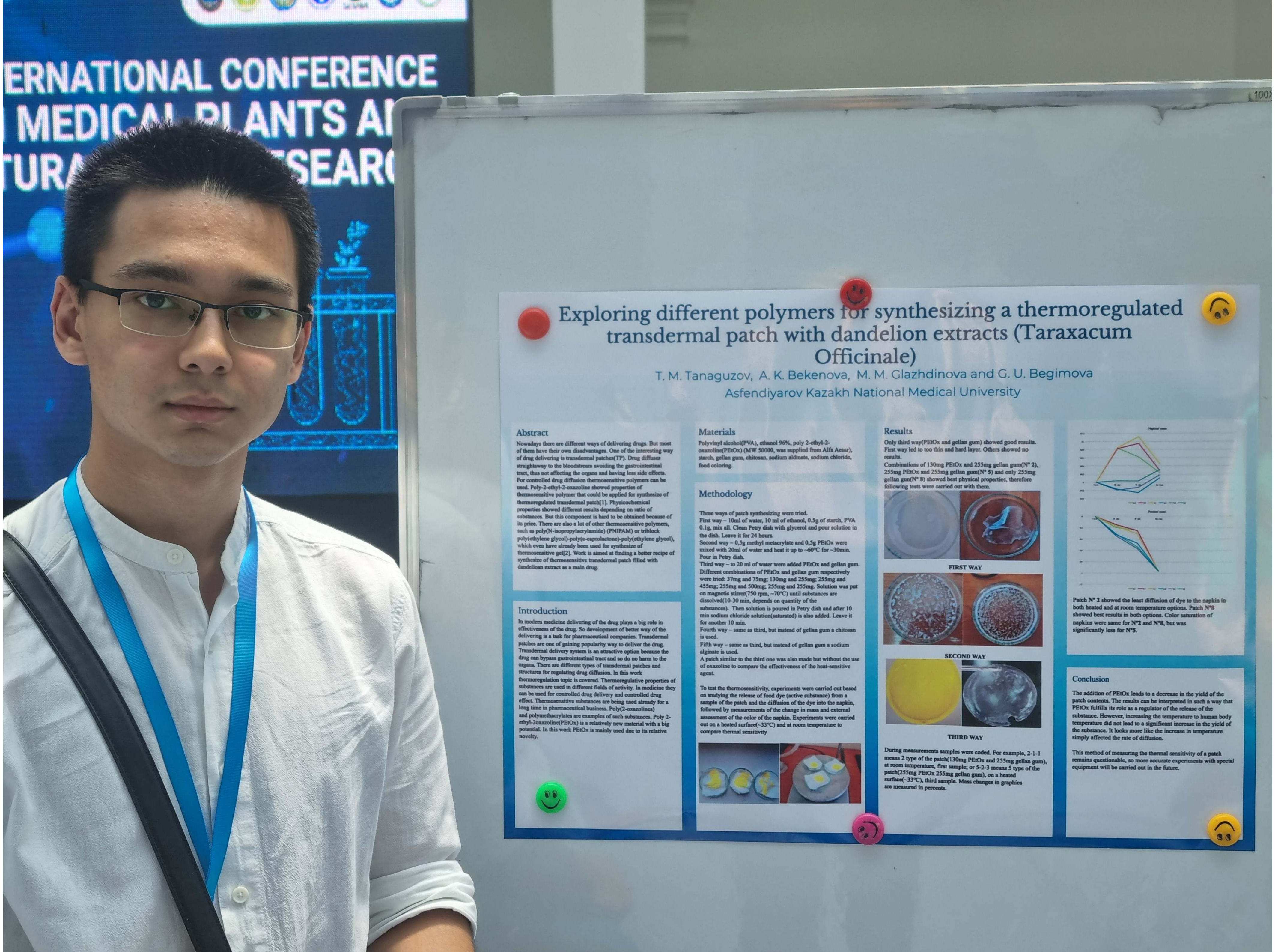
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Exploring different polymers for synthesizing a thermoregulated transdermal patch with dandelion extracts (Taraxacum Officinale)
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Abstract
Nowadays there are different ways of delivering drugs. But most of them have their own disadvantages. One of the interesting way of drug delivering is transdermal patches(TP). Drug diffuses straightaway to the bloodstream avoiding the gastrointestinal tract, thus not affecting the organs and having less side effects. For controlled drug diffusion thermosensitive polymers can be used. Poly-2-ethyl-2-oxazoline showed properties of thermosensitive polymer that could be applied for synthesize of thermoregulated transdermal patch[1]. Physicochemical properties showed different results depending on ratio of substances. But this component is hard to be obtained because of its price. There are also a lot of other thermosensitive polymers, such as poly(N-isopropylacrylamide) (PNIPAM) or triblock poly(ethylene glycol)-poly(ε-caprolactone)-poly(ethylene glycol), which even have already been used for synthesize of thermosensitive gel[2]. Work is aimed at finding a better recipe of synthesize of thermosensitive transdermal patch filled with dandelioan extract as a main drug.
Introduction
In modern medicine delivering of the drug plays a big role in effectiveness of the drug. So development of better way of the delivering is a task for pharmaceutical companies. Transdermal patches are one of gaining popularity way to deliver the drug. Transdermal delivery system is an attractive option because the drug can bypass gastrointestinal tract and so do no harm to the organs. There are different types of transdermal patches and structures for regulating drug diffusion. In this work thermoregulation topic is covered. Thermoregulative properties of substances are used in different fields of activity. In medicine they can be used for controlled drug delivery and controlled drug effect. Thermosensitive substances are being used already for a long time in pharmaceutical business. Poly(2-oxazolines) and polymethacrylates are examples of such substances. Poly 2-ethyl-2oxazoline(PEtOx) is a relatively new material with a big potential. In this work PEtOx is mainly used due to its relative novelty.
Materials
Polyvinyl alcohol(PVA), ethanol 96%, poly 2-ethyl-2-oxazoline(PEtOx) (MW 50000, was supplied from Alfa Aesar), starch, gellan gum, chitosan, sodium aldinate, sodium chloride, food coloring.
Methodology
Three ways of patch synthesizing were tried.
First way – 10ml of water, 10 ml of ethanol, 0.5g of starch, PVA 0.1g, mix all. Clean Petry dish with glycerol and pour solution in the dish. Leave it for 24 hours.
Second way – 0,5g methyl metacrylate and 0,5g PEtOx were mixed with 20ml of water and heat it up to ~60°C for ~30min. Pour in Petry dish.
Third way – to 20 ml of water were added PEtOx and gellan gum. Different combinations of PEtOx and gellan gum respectively were tried: 37mg and 75mg; 130mg and 255mg; 255mg and 455mg; 255mg and 500mg; 255mg and 255mg. Solution was put on magnetic stirrer(750 rpm, ~70°C) until substances are dissolved(10-30 min, depends on quantity of the substances). Then solution is poured in Petry dish and after 10 min sodium chloride solution(saturated) is also added. Leave it for another 10 min.
Fourth way – same as third, but instead of gellan gum a chitosan is used.
Fifth way – same as third, but instead of gellan gum a sodium alginate is used.
A patch similar to the third one was also made but without the use of oxazoline to compare the effectiveness of the heat-sensitive agent.
To test the thermosensitivity, experiments were carried out based on studying the release of food dye (active substance) from a sample of the patch and the diffusion of the dye into the napkin, followed by measurements of the change in mass and external assessment of the color of the napkin. Experiments were carried out on a heated surface(~33°C) and at room temperature to compare thermal sensitivity
Results
Only third way(PEtOx and gellan gum) showed good results. First way led to too thin and hard layer. Others showed no results.
Combinations of 130mg PEtOx and 255mg gellan gum(N° 2), 255mg PEtOx and 255mg gellan gum(N° 5) and only 255mg gellan gun(N° 8) showed best physical properties, therefore following tests were carried out with them.
FIRST WAY
SECOND WAY
THIRD WAY
During measurements samples were coded. For example, 2-1-1 means 2 type of the patch(130mg PEtOx and 255mg gellan gum), at room temperature, first sample; or 5-2-3 means 5 type of the patch(255mg PEtOx 255mg gellan gum), on a heated surface(~33°C), third sample. Mass changes in graphics are measured in percents.
Patch N° 2 showed the least diffusion of dye to the napkin in both heated and at room temperature options. Patch N°8 showed best results in both options. Color saturation of napkins were same for N°2 and N°8, but was significantly less for N°5.
Conclusion
The addition of PEtOx leads to a decrease in the yield of the patch contents. The results can be interpreted in such a way that PEtOx fulfills its role as a regulator of the release of the substance. However, increasing the temperature to human body temperature did not lead to a significant increase in the yield of the substance. It looks more like the increase in temperature simply affected the rate of diffusion.
This method of measuring the thermal sensitivity of a patch remains questionable, so more accurate experiments with special equipment will be carried out in the future.