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# Method for producing antibacterial adsorbent based on bentonite clay and waste photographic fixing solution

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## INTRODUCTION & AIM

Clean water plays a huge role in maintaining human health and the ecosystem as a whole. It is necessary for drinking, cooking and hygiene needs. However, water can be contaminated with various microorganisms, including Escherichia coli (Figure 1), which is an indicator of water contamination and can cause serious illness in humans, such as diarrhea, gastric upsets and can lead to death.

At the Department of General Chemistry of the Institute of Pharmacy, Chemistry and Biology of the National Research University of BelSU, adsorbents for water purification (including from bacterial contaminants) [1] and gunshot, purulent, burn wounds [2-3] based on bentonite clays were previously developed. The antibacterial effect is ensured by modifying the clay with silver. This metal can inhibit the growth and development of microflora [4].

The disadvantages of this method include the fact that a chemical reagent, silver nitrate, was previously used as a source of silver, which increases the cost of the product. To solve this problem, it was proposed to use waste photographic fixing solution as a source of silver for modification. As is known, after its use, silver remains in it in the form of soluble complex salts.

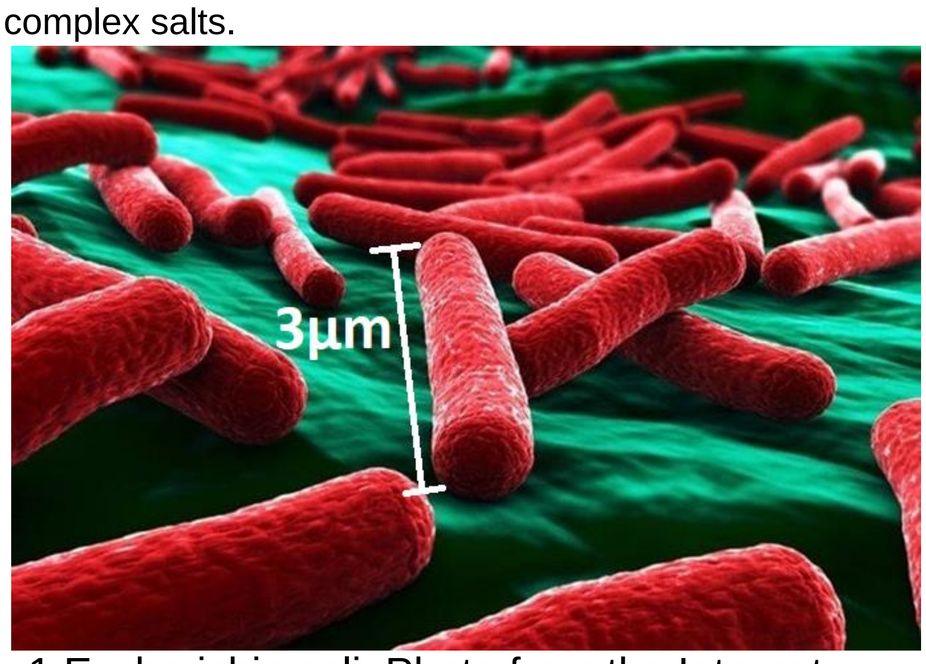


Fig.1 Escherichia coli. Photo from the Internet

## METHOD

To create the sorbent, 84 ml of the spent fixing solution was evaporated on a hot plate to 15 ml and poured into a conical flask. Then 4 ml of a 10 vol.% aqueous solution of ammonia, 5 ml of a 40 wt.% aqueous solution of NaOH, 5 ml of a 22 wt.% aqueous solution of sucrose were successively added (since it contains glucose, which has an aldehyde group, and sucrose contains keto group in open form; but if an alkaline environment is present in the solution, at high temperatures, ketoses isomerize into aldoses and also give positive reactions with an ammonia solution of silver oxide).

The conical flask was placed in a boiling water bath and stirred for 20 minutes.

Silver from soluble complexes passes into the oxide form and in the presence of the slightest impurities in the fixing solution, silver is released in the form of a gray loose sediment, rather than settling on the wall of the flask in the form of a film.

Equations of the reactions that occurred:

$$Ag_2O + 4NH_4OH \rightarrow 2[Ag(NH_3)_2]OH + H_2O$$

$$R\text{-}CH{=}O + 2[Ag(NH_3)_2]OH \xrightarrow{t} 2Ag\downarrow + R\text{-}COONH_4 + 3NH_3 + H_2O$$

The resulting precipitate was filtered off, washed with distilled water, and dried. The elemental composition of the resulting powder was determined by micro-X-ray spectral method using an EDAX energy dispersive analyzer combined with a Quanta 200 3D scanning electron microscope.

## RESULTS & DISCUSSION

| Chemical element | Content wt. % |
|---|---|
| O | 37,03 |
| Na | 5,1 |
| Mg | 2,13 |
| Al | 0,93 |
| S | 38,77 |
| K | 0,93 |
| Ag | 15,11 |

Table 1 Results of elemental analysis of silver-containing product

## CONCLUSION

- A silver-containing product has been obtained which is recommended for use in modifying bentonite clay in order to impart antibacterial properties to it.

## FUTURE WORK / REFERENCES

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