

# DETERMINATION OF ORGANIC CATIONS IN A SURFACTANT-MODIFIED SYSTEM Mo(VI) - BROMIPYROHALOL RED BY MOLECULAR SPECTROSCOPY METHODS

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Surfactants are widely used in the analysis not only as analytes, but also as ligands, which on the one hand are able to create classical organized environments, and on the other - to show specific properties interacting with reagents. In general, surfactant solutions in the analysis are characterized by several aspects of use [1, 2]. Firstly, surfactants can be objects of analysis. Secondly, they can be used as reagents. Also, surfactant solutions are used as modifiers of reagent systems, analytical forms and as a medium for analytical reactions. At the same time, surfactants are widely used in many industries, which, in fact, makes them important objects of determination and necessitates control over their composition in detergents, cosmetics, medicines, as well as in the analysis of various types of water.

The main analytical forms for the determination of ionic surfactants are their associates with counterions of organic reagents and complexes of ionic associates. The complexation of metal ions with organic reagents in the surfactant medium is often accompanied by a 2-10-fold increase in light absorption, as well as a bathochromic shift of the maximum wavelengths [3]. This effect of surfactants can be explained by changes in the hydration of particles in solution, an increase in the number of ligands coordinated by the metal ion, a shift in the pH of the formed complex to a more acidic region and increase of chelates' stability in solution. Due to this specific action, it is possible to expand the scope of photometric, fluorimetric, electrochemical methods of analysis and methods of separation and concentration significantly.

In recent years, digital colorimetry has proven to be a rational and competitive method of analysis [4]. This method makes possible to create new methods of determination, which are characterized by improved metrological characteristics with the possibility of simultaneous analysis of several samples. Systems such as metal ion - organic reagent - surfactant, which are maximum contrast, are the most interesting for colorimetric determinations.

Therefore, the aim of the work was to develop optimal conditions for spectrophotometric and colorimetric determination of hydrophobic organic compounds of cationic nature in the hydrophobically modified system Mo(VI) - bromopyrohalol red (BPR). The choice of metal-reagent system is explained by its high contrast of formation reactions of three-component complexes Mo(VI) – BPR – organic cation in solutions.

The interaction of molybdenum with BPR in the presence of cationic and nonionic surfactants was studied by spectrophotometric and colorimetric methods. Researches have shown that additional hydrophobization of the metal-reagent system Mo(VI) – BPR with adding the nonionic surfactant Triton X-100 (TX-100) allows to expand the range of linearity and improve the sensitivity of spectrophotometric determination of cationic cetylpyridinium chloride (CPC).

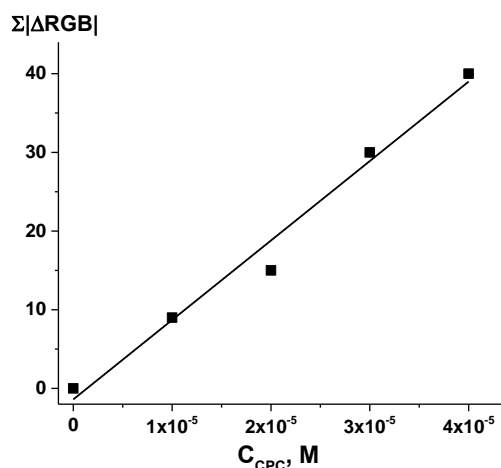
Developed optimized conditions of the hydrophobized metal-reagent three-component system Mo(VI) – BPR – Triton X-100 were used in the determination of protein products. Using a hydrophobic-modified metal-reagent system, it was possible to reduce the detection limit of gelatin by almost three times compared to the same aqueous system. It was found that in the range of gelatin concentrations of 0-5 mg/l, the light absorption of the system increases linearly (LOD = 0.5 mg/l). The correctness of the obtained results was checked by the method of «introduced-found» in the analysis of model solutions with known gelatin composition. Studies indicate the feasibility of using surfactant-modified system Mo(VI) – BPR in the determination of protein substrates (Table 1).

**Table 1.** The results of spectrophotometric determination of gelatin in the hydrophobic system Mo(VI) – BPR – CPC – TX-100.  $C_{Mo}=1,0 \cdot 10^{-5}$  M,  $C_{BPR}=2,0 \cdot 10^{-5}$  M,  $C_{CPC}=2,0 \cdot 10^{-5}$  M,  $C_{TX-100}=2,0 \cdot 10^{-5}$  M, pH=3,0, n=5, p=0,95

Introduced, mg/l	Found, mg/l	S <sub>r</sub>
1,0	0,99±0,02	0,013
2,0	2,01±0,03	0,021
3,0	2,99±0,03	0,022
4,0	4,00±0,01	0,005

In this work are also optimizes the conditions for determination of the CPC in the system Mo(VI) - bromopyrohalol red using colorimetric method. The recording of the total RGB signal characteristics of the investigated solutions was performed using a scanner providing Petri dishes, while registering the signal of the solutions and the colored filter paper surface. The scanner brightness parameter was previously optimized to capture the color characteristics of Mo(VI) –BPR solutions. Thus, it was found the optimal values of brightness for the painted surface – «-35» and «0», for solutions – «15» and «60».

Under optimized conditions, the colorimetric characteristics of the Mo(VI) – BPR system were recorded depending on the cationic surfactant concentration. It is established that the colorimetric determination of CPC in the Mo(VI) – BPR system using solutions is characterized by better metrological parameters, in particular the sensitivity of cationic surfactant determination, than using colored filter paper surface. In this case, it is advisable to record the color characteristics of the studied systems using Petri dishes at the brightness of the scanner «60» (Figure 1).



**Fig. 1.** Dependence of the colorimetric signal of the CPC in the system Mo(VI) – BPR, registered using Petri dishes.  $C_{Mo}=1,0 \cdot 10^{-5}$  M,  $C_{BPR}=2,0 \cdot 10^{-5}$  M, pH=3,0

In conclusion, this work proposes optimal conditions for spectrophotometric determination of hydrophobic organic compounds of ionic nature, in particular protein substrates, in the hydrophobic-modified Mo(VI) – BPR system. Has been registered a decrease in the detection limit of organic cations in the nonionic surfactants modification of the metal-reagent system. Were defined the optimized conditions for registration the colorimetric signal of hydrophobic organic cations using the determination of CPC in the system Mo(VI) – bromopyrohalol red. It was found that the colorimetric determination of hydrophobic organic compounds of cationic nature in the Mo(VI) – BPR system using Petri dishes (signal registration of solutions) is characterized by better metrological parameters compared to filter paper (colorimetry of the colored surface).

#### References:

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