

UDC 541.49:546.812

A.I.Khalitova, N.D.Kushekova, A.F.Kurmanova

*Ye.A.Buketov Karaganda State University  
(E-mail: khalfiya2212@inbox.ru)*

### Research of complexation of quercetin with tin (II) in water – ethanol medium

In this work the interaction between quercetin and tin (II) ions in water-ethanol medium was studied. The optimal conditions of the complex formation were found for the system: quercetin – tin (II) – water – ethanol by using spectrophotometric method. The influence of different factors on complexation was investigated.

*Key words:* spectrophotometric method, quercetin, tin (II), water – ethanol medium, complex formation, flavonoid.

At the present time tin is widely used in the ferrous and nonferrous metallurgy, food processing industry, organic synthesis [1]. Due to the intensive application of tin in various spheres of ability the problem of tin's determination in various objects is very actual. Thus, there is a necessity to develop the sensitive, selective and simple methods of its determination. For this problem solution, the spectroscopic and, in particular, spectrophotometric methods are expediently used. Methods are simple for realization and accessible for equipment, therefore they are often applied in practice of chemical laboratories.

Application of ligands of organic reagents is perspective because the potential useful complex should have enough acidic and basic groups located for formation of steady five- and six-membered chelate cycles with metal ions. In this connection complexes of tin with phenolic compounds are of great interest. A numerous group of natural polyphenols are flavonoids, which are good complexing agents [2].

A typical and easily accessible flavonoid is quercetin (Fig. 1) [3].

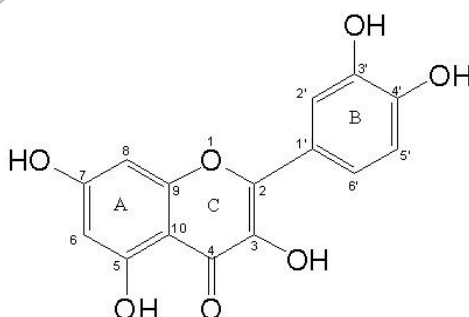


Figure 1. Quercetin

From this point of view, quercetin is recommended as valuable biologically active substance with wide spectrum of action and effective low toxic antioxidant of fat-containing food products and medicines. However the characteristic property of quercetin is insolubility in water that complicates its using as medical drug.

Many complexes of quercetin with other metals have been described in literature [4]. However information of tin (II) complexes with quercetin is practically absent. In this connection studying of the opportunity of tin (II) and quercetin complexation in water-ethanol solutions is of great scientific and practical interest.

### Experimental

*Reagents.* All chemicals were of analytical-reagent grade. A standard solution of tin (II) was prepared by dissolving an exactly weighed amount of  $\text{SnCl}_2 \cdot 2\text{H}_2\text{O}$  in distilled water and was standardized volumetrically using sodium chloride [5]. Quercetin solution was prepared by dissolving of appropriate amount of reagent in 96 % ethanol.

*Apparatus.* UV-vis absorption spectra were recorded in the spectral range of 200–700 nm against water using SHIMADZU 1800 spectrophotometer equipped with 1 cm quartz cells. Absorbance of solutions was measured using CPhC-3 photometer. Akvilon pH meter was employed for pH measurements.

### Results and discussion

The preliminary experiments showed that tin (II) reacted with quercetin in water-ethanol solutions to form a yellow-green compound. The UV-vis spectrum of initial flavonoid showed two absorption bands, while complex showed three ones (Fig. 2). And besides the first two bands were identical for both samples: 250 nm and 375 nm. However, as regards the complex spectrum, it is shown that the third absorption band is appeared at 440 nm. Thus UV-vis spectra proved the formation of a new quercetin – tin (II) complex in water – ethanol medium.

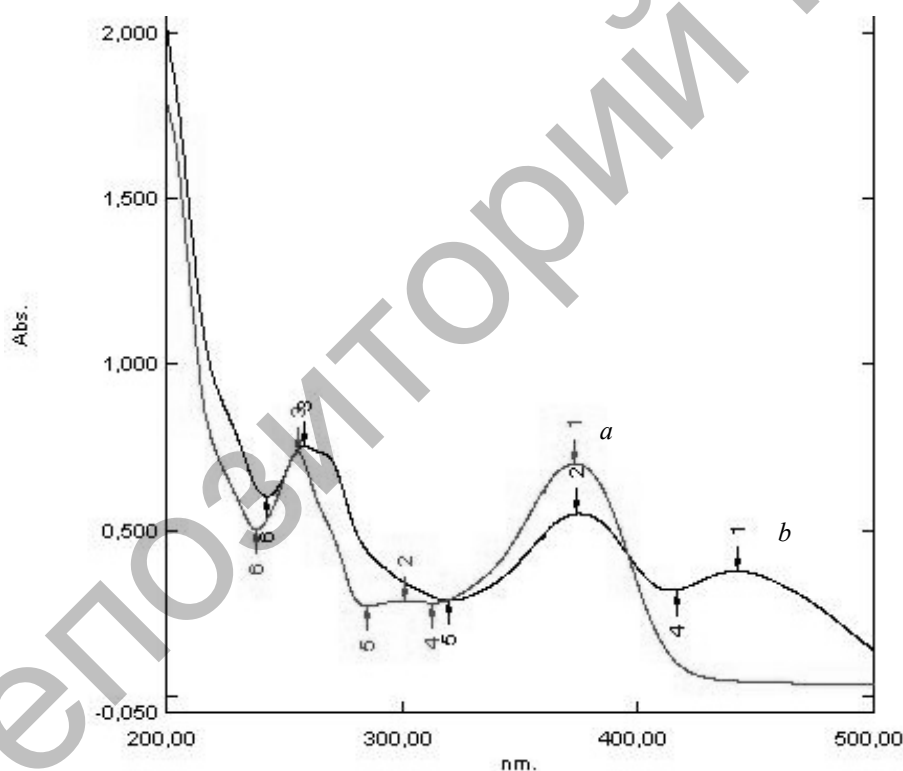


Figure 2. UV-vis spectra of quercetin (a) and its complex with tin (II) (b)

When selecting optimal conditions for complex formation it was necessary to research the influence of different factors on this process.

*Effect of time.* During the preliminary experiments it was determined that an absorbance of the complex was changing within time. As it is seen from Figure 3, absorbance increases during 15 minutes, then it decreases slowly and remains constant after 40 minutes from the beginning of the experiment. Thus, further researches were made after 15 minutes from solutions' preparation.

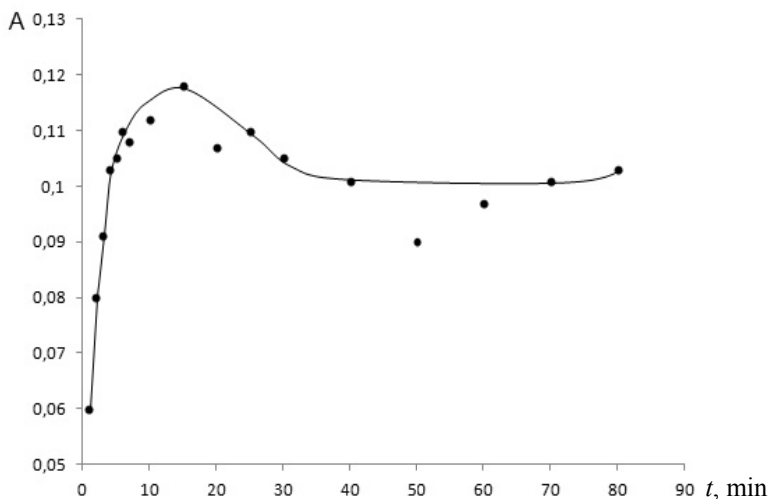


Figure 3. Kinetic curve of tin (II) – quercetin complex

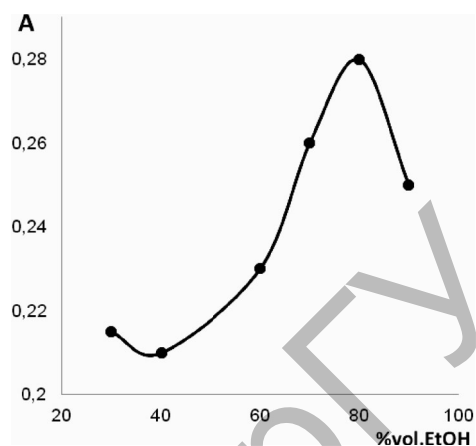


Figure 4. Effect of solvent

*Effect of solvent.* As it was mentioned earlier, quercetin is insoluble in water, but it can be successfully dissolved in many organic solvents, in particular, in ethanol. As regards quercetin – tin (II) complex, its solubility in water is also not good. For this reason, further experiments were carried out in water – ethanol medium. It was established, that if the content of ethanol was lower 30 % vol., complex formed a precipitation.

In the Figure 4 the dependence of quercetin – tin (II) complex absorbance on solvent's concentration is presented. As the received results show, with the increase of ethanol concentration, the absorbance of complex solution increases too up to 80 % vol. and then it goes down. The character of the curve obtained allows to propose that water molecules in the inside coordination sphere of tin (II) ions are substituted by the ethanol ones. This process is accompanying with the growth of absorbance. When alcohol content becomes more than 80 % vol. the substitution of quercetin molecules by the ethanol ones occurs. That's why further decrease of the absorbance is observed. Therefore, it can be proposed, that alcohol molecules comprise in complex's structure.

#### Conclusion

Thus, as the result of complexation reaction between quercetin and tin (II) a new compound was synthesized and optimization of reaction conditions in water – ethanol medium was carried out. It was shown that the complex formation depended on time and ethanol content in the system. It was also established that ethanol molecules could be included in the structure of the complex.

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А.И.Халитова, Н.Д.Кушеикова, А.Ф.Курманова

### Сулы – этанолды ортада кверцетиннің қалайымен (II) комплекс түзуін зерттеу

Мақалада сулы–этанолды ортада кверцетин мен қалайы (II) иондары арасындағы әрекеттесулер зерттелді. Спектрофотометриялық әдісті қолдану арқылы кверцетин – қалайы (II) – су – этанол жүйесінде комплекс түзілудің оңтайлы жағдайлары табылды. Кешеннің түзілуіне әр түрлі факторлардың әсері зерттелді.

А.И.Халитова, Н.Д.Кушекова, А.Ф.Курманова

**Исследование комплексообразования кверцетина с оловом (II)  
в водно-этанольной среде**

В статье изучено взаимодействие между кверцетином и ионами олова (II) в водно-этанольной среде. Были найдены оптимальные условия образования комплекса в системе кверцетин – олово (II) – вода – этанол с использованием спектрофотометрического метода. Было исследовано влияние различных факторов на образование комплекса.

Репозиторий КарГУ