

UDC: 599:539.1.047

SYNTHESIS AND STUDY OF THE RADIOPROTEKTIVE PROPERTIES OF A COMPLEX OF ZINC WITH TRYPTOPHAN

G.E. Gasimova¹, A.S. Aghayeva¹, A.S. Abdullayev¹, E.N. Shamilov¹, Sh.I. Qahramanova², F.F. Jalaladdinov², R.H. Hamidov², I.V. Azizov³

¹*Institute of Radiation Problems of ANAS*

²*Institute of Catalysis and Inorganic Chemistry of ANAS*

³*Institute of Molecular Biology and biotechnology of ANAS*

sahnaz.gahramanova@gmail.com

Abstract: New complex compound with tryptophane of the complexes $[Zn(trp)_2(H_2O)_2]$ were synthesized. It is shown that the composition of the complex obtained depends on the ratio of the initial components. The composition and structure of the complex were studied by elemental analysis, IR, X-ray phase analysis and thermogravimetric analysis. The method of IR spectroscopy showed that the ligand in the complex of the metal (II) complexes enter the neutral form and coordinate with the complexing agent through the nitrogen atom. The results of thermogravimetric studies have shown that the final product of the thermal decomposition of all compounds is metal oxide, respectively. The effect of the zinc-tryptophan complex (Zn-trf) on the biosynthesis of photosynthetic pigments and morphological parameters of seedlings of irradiated wheat seeds was studied. Initial experiments showed that, when treated seeds with the (Zn-trf) complex, their resistance to gamma rays is increased. On the basis of the data obtained, it can be concluded that the complex (Zn-trf) has radio protective properties.

Keywords: zinc, tryptophan, complex, metal oxide, amine groups, IR spectroscopy, thermogravimetry, photosynthetic pigments, radioprotective

1. Introduction

The chemistry of complex compounds of transition metals with multidentate ligands, which simultaneously contain several donor atoms, is not only theoretical but also of practical interest, since in addition to the unusual properties of such complexes, the structure and types of binding of multidentate ligands with different metals give a new impetus to the development coordination chemistry as a whole. Among the coordination compounds, the complexes obtained on the basis of biomaterials take a special place. This is due to the fact that they play an important role in many biochemical processes and therefore are widely used in plant growing, animal husbandry, and pharmacology. In turn, the study of the properties and structure of coordination compounds of metal ions with organic ligands containing various donor centers was an important factor in the development of new approaches to their physico-chemical research.[1-3]

On the other hand, complex compounds of many transition elements can possess a wide range of useful properties, for which the chemistry of complex compounds has not yet been sufficiently studied [4-8].

In this paper, we present methods of synthesis and study of the properties of zinc (II) complexes with ligand (*tryptophane*)

2. Physical measurements

The composition and chemical structure of the synthesis products obtained are studied by physical-chemical analysis methods: elemental analysis (ICP-MS); X-ray phase analysis (diffractometer (Germany) D-2 Phaser firm Bruker); IR spectroscopy ("Specord M-80" brand Carl Zeiss). Differential thermogravimetric analysis was performed on (NETZSCH STA 449F3 STA449FSA-0622-M).

3. Experimental part

Synthesis $-\text{[ZnL}_2(\text{H}_2\text{O})_2] - (\text{L}=\text{tryptophan})$: To a beige color solution obtained by dissolving 0.65 g (0.01 mole) $-\text{Zn}$ powder in 20 ml of ethyl alcohol, 2.04 g (0.01 mole) of ligand L-tryptophan dissolved in 30 ml of ethyl alcohol (in a molar ratio 1: 1). The solution was heated for 2-2.5 hours at a temperature of 60°C . Further, the synthesis process was carried out according to the above described procedure. pH-7

4. Results and conclusion

IR spectroscopy

To determine the coordination character of the synthesized complex compounds formed between the ligand and the zinc, IR spectroscopic analysis was carried out. In the region of $\nu_{\text{NH}} = 3408.37 \text{ cm}^{-1}$ of the tryptophan molecule, the absorption band of the valence vibration of the NH bond of the double amino group in the indole ring is observed. In the $\nu_{\text{NH}} = 3038 \text{ cm}^{-1}$ region of the NH^3+ band, the valence vibration of the NH bond and the valence vibration of the aromatic rings overlap. Vibrations the asymmetric valence of the C = O bond in the COO^- ion is observed at 1663 cm^{-1} . This testifies that, the tryptophan molecule is free for fast ion

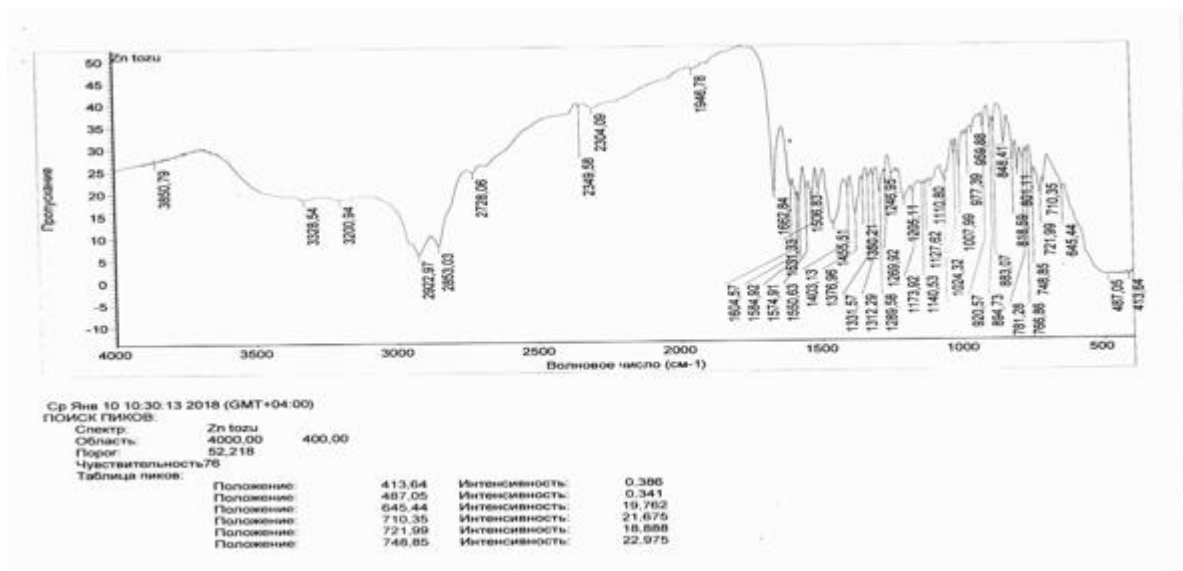


Fig.1. IR spectra of complex $[\text{ZnL}_2(\text{H}_2\text{O})_2]$

When the IR spectra of the free ligand are aligned with the spectra of the complexes obtained, an obvious change is observed. In the reaction of zinc with a tryptophan molecule, the double absorption bands of amine NH tryptophan $\nu_{\text{NH}} = 3402, 73 \text{ cm}^{-1}$ and $\delta_{\text{NH}} = 738.16 \text{ cm}^{-1}$

disappear. A comparative analysis of the results of IR spectral analysis shows that a crystalline complex of the ionic type of tryptophan and Zn is synthesized

Differential Scanning Calorimetry

With the definition of the thermic stability and the composition of synthesized complexes $[ZnL_2(H_2O)_2]$. the thermographic analysis was made

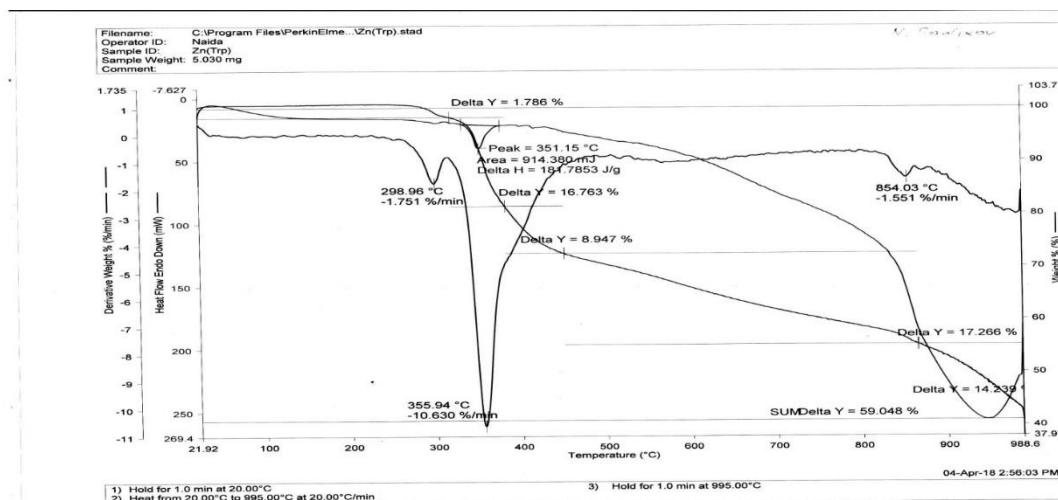


Fig.2. Thermogram complex $[ZnL_2(H_2O)_2]$

Thermocouples were used to determine the composition and durability of the synthesized complex compound and it was established that the complex is resistant to a temperature 298°C. At higher temperatures, the complex gradually breaks down, and this process ends in several stages, and in all cases the final product of the thermolysis process consists of metal oxides. Thus, according to the results of the physico-chemical methods used in the work, it is established that the composition and structure of the complexes obtained directly depends on the ratio of the initial product

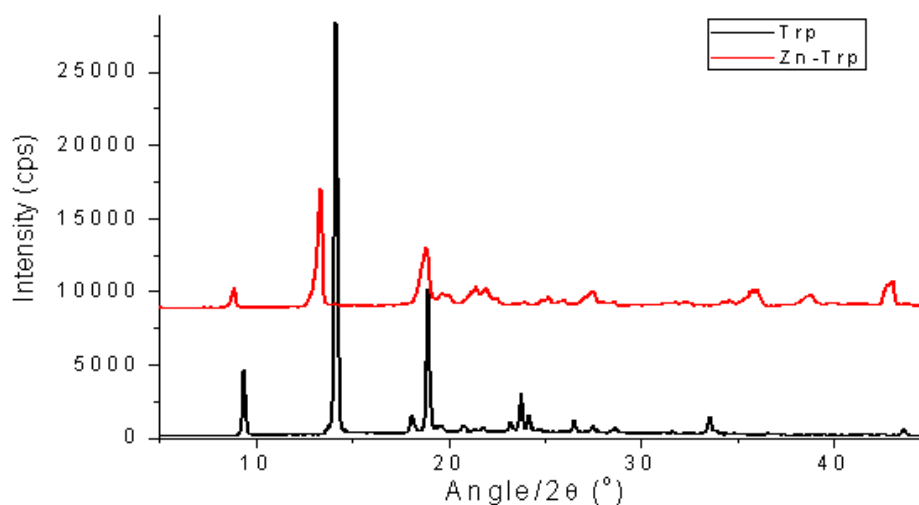


Fig. 3. shows the result of X-ray phase analysis of the synthesis product. The interpretation of the obtained data also confirms the formation of the $[ZnL_2(H_2O)_2]$ complex.

Since the parameters of the crystalline cell differ from each other, a coordination complex Zn- tryptophan was created. Tryptophan peaks did not appear in Zn- tryptophan, but almost all complexes were created

To determine the composition and thermal stability of the complexes under study, we performed elemental and thermogravimetric analysis. The results of the investigations showed that in all cases the final product of the thermal decomposition of the complexes is metal oxide. Thus, according to the results of the physico-chemical methods used in the work, it is established that the composition and structure of the obtained complexes directly depends on the ratio of the initial products.

Effect of the zinc-tryptophan complex (Zn-trf) on biosynthesis of photosynthetic pigments and morphological parameters of seedlings of irradiated wheat seeds with 300 Gy gamma radiation

The effect of the zinc-tryptophan complex (Zn-trf) on the biosynthesis of photosynthetic pigments and morphological parameters of seedlings of irradiated wheat seeds was studied. Before irradiation, wheat seeds were treated with 0.1%; 0.01% and 0.001% solution of the complex. At the next stage, the dried seeds were gamma irradiated with 300 Gy from a ⁶⁰Co source. Further, they were planted in the soil and the development of seedlings was studied. Further, they were planted in the soil and germination, growth of seedlings, and the dynamics of the formation of photosynthetic pigments were studied. Initial experiments showed that, when treated seeds with the (Zn-trf) complex, their resistance to gamma rays is increased. Germination of untreated seeds was low compared with treated seeds. The content of chlorophyll a, b and carotenoids was higher in the seedlings of the treated seeds than in the untreated ones (Table1).

Table 1. Influence of Zn-trf complex with amino acids on content of chlorophyll and carotenoids in leaves of wheat seedlings of irradiated wheat seeds with 300 Gy gamma radiation (mg/l)

Variants	Chlorophyll a	Chlorophyll b	Carotenoids
Control	2,33	1,29	0,67
Zn-trf (0.001%)			
	1,71	0,89	0,60
Irradiated 300 Gy			
Control	1,39	0,52	0,49
Zn-Trf (0.1%)	1,68	0,75	0,61
Zn-Trf (0.01%)	1,71	0,83	0,59
Zn-Trf (0.001%)	1,73	0,91	0,63

On the basis of the data obtained, it can be concluded that the complex (Zn-trf) has radio protective properties.

The work was performed by the financial support of the project STCU under number 6282

References

1. Gahramanova Sh.I., Kuliyeva.E.A., Azizov. I.V. Influence of newly synthesized zinc complexes with amino acids on the morphophysiological characteristics of wheat seedlings. // Academic Journal of West Sibiuryi. 2014. № 5. T.10. P. 94-95. [In Russian].
2. Kakhrmanova Sh. I., Guliyeva.E.A., Suleymanov G.Z., Azizov.I.V. Influence Newly Syntesized Manganese Complexes with Amino Asids on Morphophysiological Chracteristics Wheat Germ. American International Journal of Contemporary Research Vol.4, No. 12; December 2014.P.58-60
3. Mahmudov K. T., Sutradhar M., Martins L., Silva F. C, Ribera A., Nunes V. M., Marchetti F., Pombeiroa A. L., Gahramanova Sh. I., Mn(II) and Cu(II) complexes with arylhydrazones of active methylene compounds as effective heterogeneous catalysts for solvent and additive-free microwave-assisted peroxidative oxidation of alcohols. // RSC Advances An international journal to further the chemical sciences. The Royal Society of Chemistry. 2015. 5, P. 25979–25987.
4. Gahramanova Sh. I., Gulieva E.A, Suleimanov G.Z, Karimova U.A, Asgarova T. Y. Interaction of manganese (II) with valine and β -alanine // International Youth Scientific and Practical Conference of Students, graduate students and young "Fundamental and applied research in the field of chemistry and ecology", (Kursk September 23 - September 26, 2015). Pp. 29-31.
5. Alam S.M., Shereen A. Effect of different levels of Zinc and Phos-phorus on growth and chlorophyll content of wheat // Asian J. of plant sciences. – 2002. – № 3. – P. 304-306. and mineral contents of hidroponically mungbeans plant (*Vigna radiata*) // Arabian J. of Chemistri. – 2013. – P. 1-7.
6. Mortverdt J.J., Giordano P.M. 1969. Availability to com of zinc applied with macro nutrient fertilizers // Soil. Sc. – 1969. – № 108. – P. 180-187.
7. Tayyeva H., Humid U. Sh., Muhammad J. Zinc effect on grown rate, chlorophyll, protein and mineral contents of hidroponically mungbeans plant (*Vigna radiata*) // Arabian J. of Chemistri. – 2013. – P. 1-7.
8. Viets F.J. Zn deficiency in the soil plant system // C. Thomas pub-lisher. Springfield, USA, 1966. – P. 90-127.

СИНТЕЗ И ИССЛЕДОВАНИЕ РАДИОЗАЩИТНЫХ СВОЙСТВ КОМПЛЕКСА ЦИНКА С ТРИПТОФАНОМ

Г.Э. Гасымова, А.С. Агаева, А.С. Абдуллаев, Э.Н. Шамилов,
Ш.И. Кахраманова, Ф.Ф. Джалаладдинов, Р.Г. Гамидов, И.В. Азизов

Резюме: Синтезировано комплексное соединение цинка с триптофаном $[Zn(trp)_2(H_2O)_2]$. Показано, что состав полученного комплекса зависит от соотношения исходных компонентов. Состав и структура комплекса изучались методом ИК, элементного, рентгенофазового и термогравиметрического анализа. Метод ИК-спектроскопии показал, что лиганд в комплексе координируется с металлом через атом азота. Результаты термогравиметрических исследований показали, что конечным продуктом термического разложения является оксид металла. Изучено влияние комплекса (Zn-Trf) на биосинтез фотосинтетических пигментов и на морфологические параметры проростков облученных семян пшеницы. Начальные эксперименты показали, что при обработке семян комплексом (Zn-Trf) их устойчивость к гамма-лучам увеличивается. На

основании полученных данных можно сделать вывод, что комплекс (Zn-Trf) обладает радиозащитным свойством.

Ключевые слова: цинк, триптофан, комплекс, оксид металла, аминогруппы, ИК-спектроскопия, термogravиметрия, фотосинтетические пигменты, радиозащитный

SİNKİN TRİPTOFANLA KOMPLEKSİNİN SİNTEZİ VƏ RADİOQORUYUCU XASSƏLƏRİNİN ÖYRƏNİLMƏSİ

G.E. Gasımova, Ə.S. Ağayeva, A.S Abdullayev, E.N. Şamilov, Ş.İ. Qəhrəmanova, F.F. Cəlaləddinov, R.H. Həmidov, İ.V. Əzizov

Xülasə: Sinkin triptofanla $[Zn(trp)_2(H_2O)_2]$ tərkibli kompleksi sintez edilmişdir. Alınan kompleksin tərkibinin ilkin komponentlərin nisbətindən asılı olması müəyyənləşdirilmişdir. Kompleksin quruluşu və tərkibi İQ spektroskopiya, element, rentgen(X) faza və termogravimetrik analizlərlə tədqiq edilmişdir. İQ-spektroskopiya üsulu kompleksin tərkibində olan liqandın azot atomu vasitəsilə koordinasiya olduğunu göstərir. Termogravimetrik tədqiqatların nəticələri termiki parçalanmanın yekun məhsulunun metal oksidi olduğunu göstərmişdir. Sink-triptofan (Zn-Trf) kompleksinin şüalandırılmış buğda toxumlarından əmələ gələn cücərtildə fotosintez piqmentlərinin biosintezinə təsiri tədqiq edilmişdir. Alınmış ilkin nəticələr toxumların komplekslə işlənməsinin onların şüalanmaya qarşı müqavimətinin artdığını göstərir. Alınan ilkin təcrübi nəticələr kompleksin radioprotektor xassəyə malik olduğunu göstərir.

Açar sözlər: sink, triptofan, kompleks, metal oksidi, aminogruplar, İR spektroskopiya, termogravimetriya, fotosintetik piqmentlər, radioqoruyucu