World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-16, November 2022
ISSN: 2749-3644

SYNTHESIS OF METALLOCOMPLEXES OF SCHIFF BASES AND THEIR STRUCTURAL ANALYSIS

Khakberdiyev Shukhrat Mahramovich
Mamatova Farangiz Qodir qizi
E-mail: h.shyxrat81@gmail.com
Jizzakh Polytechnic Institute

Article history:

Received: September 13th 2022
Accepted: October 14th 2022
Published: November 20th 2022

Abstract:

Physicochemical properties of gossypol, their Schiff bases and metallocomplexes were synthesized. When synthesizing derivatives of Schiff's bases, gossypol and primary chiamine are taken in a 1:2 mol ratio, enough 96 % ethyl alcohol is poured for its dissolution and stirred for three hours while heated in a magnetic stirrer. The structure of all obtained substances was analyzed using IR and UV spectra.

Keywords: Gossypol, amino compound, Schiff's base, spectrum, biologically active substance, metallocomplex, polyphenol, triterpene, aldehyde, cotton plant, naphthalene

INTRODUCTION

While the pharmaceutical industry is rapidly developing in the world, there is an increasing need to extract biologically active substances from the composition of plants and to create drugs that have an effective effect and do not have harmful effects. Therefore, chemical modification of natural compounds; It is of great importance to create low-dose, water-soluble and wide-therapeutic drugs with the help of complex forming compounds, and to develop their new technologies.

Gossypol is a specific polyphenolic compound and is considered the main polyphenolic compound of the cotton plant. belongs to the group of triterpene aldehydes and is found in plants called Gossipium. Among such plants, the cotton plant is included, in various parts of it, including leaves, roots, and other parts of the body in different amounts (up to 0.56-3 %, depending on the type of cotton). Occurs [1-2-3].

Gossypol is an amorphous, crystalline, lemon-yellow natural substance that is soluble in various organic solvents. In addition to the presence of various polar groups in the gossypol molecule, it is almost insoluble in water due to the presence of two isopropyl groups in the naphthalene residue [4-5].

Gossypol is very soluble in methyl, ethyl, isopropyl and butyl alcohols, as well as in diethylene glycol, dioxane, acetone, diethyl ether, ethyl acetate, chloroform, carbon tetrachloride, dichloroethane, phenol, pyridine and heated naphthalene, heated cottonseed oil. In addition, gossypol is soluble in limited amounts in glycerol, cyclohexane, benzene, gasoline, and petroleum ether [6-7-8].

THEORETICAL PART

As a result of a series of studies, it was determined that the aldehyde groups in the gossypol ($C_{30}H_{30}O_8$) molecule form internal hydrogen bonds with the two oxygen atoms of the hydroxyl groups in the second -ortho position [9-10].

Substances formed as a result of the reaction of substances containing an amino group with gossypol are called Schiff bases or azomethine derivatives. When synthesizing derivatives of Schiff's bases, gossypol and primary chiamine are taken in a 1:2 mol ratio, enough 96% ethyl alcohol is poured in to dissolve it, and it is stirred in a heated state (70-80 ^{0}C) in a magnetic stirrer for three hours, the progress of the reaction is monitored using YuQX. After the reaction is complete, the resulting substance is left for one day to settle completely, then it is filtered and washed 2-3 times with ethyl alcohol. The obtained substance is dried in a place where sunlight does not fall [11-12].

Table 1
Physicochemical quantities of synthesized Schiff bases

№	Synthesized Schiff base	Liquid ^{0}S	R_f	Color	The reaction yield is in (%).
1	Di-(2-amino-4-picoline)gossypol	213-214	0,49	yellow	89
2	Di-(6-amino-3-picoline) gossypol	209-210	0,44	yellow	92

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-16, November 2022
ISSN: 2749-3644

DISCUSSION OF RESULTS

Gossypol contains six –OH groups, two carbonyl, two methyl, two isopropyl and two naphthalene rings. In its IR-spectrum (n, cm-1) we can see the valence vibration frequencies belonging to the –OH group in the 3495, 3424 areas. The area between 1614 and 1441 indicates the presence of two naphthalene rings [13-14-15].

In the IR spectrum of the Schiff base formed by gossypol with 2-amino-4-picoline, we can see a clear change of the absorption maxima at 3240-3430 cm-1 belonging to the NH_2 group.

When analyzing the IR spectrum, it can be observed that the valence vibrations of the -CHO group at 1712 cm^{-1} have completely disappeared [16-17-18].

In the UV spectrum of the Schiff base of gossypol formed with 2-amino-4-picoline, a bathochromic shift occurs for this substance due to the absorption in the 240.54 nm branch, and the absorptions at 280, 427.98 nm are due to the hypsochromic shift of the Schiff base with N in the azomethine bond. is explained by the formation of a hydrogen bond with H of the aldehyde group in gossypol.

X-ray studies revealed the existence of two groups of isostructural clathrates, which were determined to belong to the cryptate groups KK(A) and KK(V). The cryptate group of KK(A) includes cryptates formed by gossypol with benzene, bromobenzene, isopropylbenzene, isopropylbromine and trichloroethylene. Crystals of this group have a host:guest ratio of 2:1, space group R-1, z=4 [19].

Gossypol molecules are combined into dimers through hydrogen bonds, and later, these dimers are associated with columns using hydrogen bonds. When such columns are packed into the crystal structure, they form spaces where guest molecules are located.

Gossypol and its derivatives (mainly Schiff bases of gossypol) readily form complexes with most polar (only those with proton acceptor groups) and nonpolar substances. In addition, in clathration studies of gossypol derivatives, the phenomenon of polymorphism in the formation of host-guest complexes was revealed. It has been shown that gossypol derivatives can form different crystalline modifications with the same guest component. The reason for this is that the formation of clathrate depends on the thermodynamic conditions of deposition.

Gossypol Schiff bases were reacted with Cu^{2+}, Ni^{2+} salts in a 1:2 mol ratio. The duration of the reaction was monitored hourly by thin-layer chromatography, and the obtained metallocomplexes were compared with the Schiff base spectra and the following results were obtained. The main characterizing bond of the Schiff base is the azomethine bond formed between the carbonyl in gossypol and the primary amino group. When analyzing the IR spectrum of the metallocomplex formed by Gossypol Schiff base with Cu^{2+} salt, it was concluded as follows. In contrast to the IR spectrum of the Schiff base, in the spectrum of the metallocomplex, it can be seen that the valence vibrations of the azomethine bond are shifted to the 1619 cm^{-1} region. This displacement occurs when the nitrogen atom participating in the formation of an azomethine bond forms a donor-acceptor bond with Cu^{2+} in the metallocomplex [20].

It can also be seen that the region of 3485 cm^{-1} belonging to the Schiff-based –OH group was shifted to the region of 3422 cm^{-1} in the spectrum of the metallocomplex, and a new absorption maximum appeared in the region of 3288 cm-1. These changes are related to the formation of a covalent bond between the oxygen atom of 7-OH and Cu^{2+} on the Schiff basis [21-22]. In the spectrum of the metallocomplex we can consider new absorption maxima at 544 cm^{-1} and 610 cm^{-1} as peaks belonging to metal-oxygen and metal-nitrogen bonds.

Table 2
Physicochemical quantities of Schiff base metallocomplexes

№	Synthesized metallocomplexes	solvent	Liquid ^{0}S	R_f	Color	Reaction product in (%)
1	Di-(2-amino-4-picoline)gossypol +$CuCl_2 \cdot 2H_2O$	DMFA DMSO	291-292	0,49	brown	67.8
2	Di-(2-amino-4-picoline)gossypol +$NiCl_2 \cdot 6H_2O$	DMFA DMSO	297-298	0,44	brown green	69.3
3	Di-(6-amino-3-picoline)gossypol +$CuCl_2 \cdot 2H_2O$	DMFA DMSO	300<	0,54	brown	71.3

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-16, November 2022
ISSN: 2749-3644

4	Di-(6-amino-3-picoline)gossypol +$NiCl_2 \cdot 6H_2O$	DMFA DMSO	300<	0,69	brown	70.8

System:- hexane : acetone (4:1)

Of the Schiff base formed by gossypol with 6-amino-3-picoline 236.51 for this substance when studying the UV spectrum; It gave absorption maxima at 379.1 nm.

When analyzing the UV-spectrum of the metallocomplex of the Schiff base formed by Gossypol with 6-amino-3-picoline, obtained with $CuCl_2 \bullet 2H_2O$, the metallocomplex is 247.64; It gave absorption maxima at 422.81 nm. The graph comparing these spectra to each other looked like this:
236.51 based on Schiff; The peak of the absorption maxima at 379.1 nm disappeared in the metallocomplex and the Schiff-based peak at 379.1 nm was shifted to 422.81 nm in the metallocomplex.

When analyzing the IR spectrum of the Schiff base formed by gossypol with 6-amino-3-picoline, obvious changes occur in the region of absorption maxima belonging to the NH2 group at 3120.44 cm-1. Based on Schiff, we can see that the surface and the distance between these peaks have expanded. These expansions occur due to Schiff-based hydrogen bonds. As a result, we can see absorption maxima at 1714.68 cm-1 due to valence vibrations of the new –N=CN– bond.
It is a Schiff base and the metallocomplex formed with $CuCl_2 \bullet 2H_2O$ when analyzing the IR spectrum at 2966.25 cm^{-1}
that the absorption maxima caused by valence vibrations of the –N=CN– bond have not changed and 3479.34; Absorption maxima were observed at 3411.77 cm^{-1} due to coordination bonds in the metallocomplex. In the IR-spectra of the obtained metallocomplexes, the change of the valence vibration lines belonging to the OH group (area 2740-3300 cm^{-1}) and the weakening of the vibration frequencies of the azomethine bonds (area 1600-1627 cm^{-1}) is observed; M-O (area 450-490 cm^{-1}) lines appear.

Table 3
Cu^{2+}, Ni^{2+} tuzlari metallokomplekslarining fizik-kimyoviy konstantalari

№	Birikmalar	Collor	Reakseya unumi	Ts-°S	-C=N cm^{-1}	C-O cm^{-1}	M-O cm^{-1}	M-N cm^{-1}
1	Di-(2-amino-4-picoline) gossypol	yellow	89	213-214	1617	1333	-	-
2	Di-(2-amino-4-picoline) gossypol +$Cu \cdot 2H_2O$	brown	67.8	291-292	1621	1337	519	484
3	Di-(2-amino-4-picoline) gossypol +$Ni \cdot 2H_2O$	brown green	69.3	297-298	1603	1337	577	456

When studying the structure of metal complexes using UV spectroscopy, the presence of azomethine bonds (λC=N=272 nm) is proven by the appearance of an absorption line in the 260-300 nm range.

Information about p-p* and n-p* transitions of electrons in the molecule is confirmed by the appearance of absorption lines in the region of 330-370 nm, d-d electron transitions in the region greater than 500 nm.

Table 4
UV spectra of Schiff base metallocomplexes

Birikma	Electronic spectrum (nm)				The geometric shape of the complex	Metals hybridization
	п→п	n→п	L→M	d→d		
Gossypol	295	370	-	-	-	-
Di-(2-amino-4-picoline) gossypol +$Cu \cdot 2H_2O$	330	365	465	680	Octahedron	sp^3d^2
Di-(2-amino-4-picoline) gossypol +$Ni \cdot 2H_2O$	310	372	470	535 596		d^2sp^3

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-16, November 2022
ISSN: 2749-3644

Metallocomplexes were analyzed on a NexION 2000 (Perkin Elmer, USA) mass spectrometer adapted to study the composition of organic compounds. For this, mineral acid purified by distillation was used in Bergof (Germany) equipment. First, metallocomplexes of Schiff bases synthesized on the basis of gossypol were put into a microwave disintegration device and dissolved in purified mineral acids for 10 minutes. Measurements of the amount of metal ions in the solution sample were carried out, in which the collision mode (KED) was selected in order to eliminate noise. The indicator of detection of ions in the analyzed sample was 10-13 g/ml.

Theoretically, the amount of metals in the metallocomplexes obtained with Cu^{2+}, Ni^{2+} salts was calculated, and the average values were statistically calculated five times in practice (ISP-MS).

Table 5
The amount of metals in metal complexes of Cu^{2+}, Ni^{2+} salts of Schiff bases

№	Metallocomplex	Theoretical %	Practical %					Average value
1	**Cu^{2+}**	4.39	3.95	4.11	3.87	4.29	3.98	4,040
2	**Ni^{2+}**	4.07	3.86	3.93	3.72	3.98	4.00	3,898

Crystalline properties of gossypol, gossypol derivatives and metallocomplexes were determined by powder diffractometry XRD-6100 (Shimadzu, Japan). It was performed under the influence of CuKa radiation (b-filter, Ni, λ=1.54178Å, current and voltage in the X-ray tube 30 mA, 30 kV). In this case, the constant rotation speed of the detector was 4 degrees/min, in steps of 0.02o (ω/2th-link), and the scanning angle was taken from 4o to 80o. The samples were analyzed in a rotary chamber with a rotation speed of 30 rpm.

In this device, it was studied whether substances are crystalline or non-crystalline. Gossypol, gossypol derivative di-(2-amino-4-picoline)gossypol and metallocomplexes of di-(6-amino-3-picoline)gossypol obtained with $NiCl_2 \cdot 6H_2O$ were found to be crystalline substances. The crystallinity of all substances differs from each other, so it can be concluded that the difference in the crystallinity of substances also indicates the formation of a new substance.

CONCLUSION

The reaction yield, physico-chemical parameters, structure, UV and IR spectra of the obtained substances were studied, and the obtained results showed that they can be used as initial data in the synthesis of biologically active substances in the future.

Schiff bases of gossypol formed with 2-amino-4-picoline, 6-amino-3-picolines in single crystals dissolved in acetone with solvent molecules, gossypol derivatives form clathrates due to hydrogen bonds, and this shows that the addition of various solvents allows obtaining different clathrates of substances as a result of lash.

The stability of metallocomplexes is less dependent on the nature of the ligand, and the stability corresponds to the Irving-Williams series in which the change Cu>Ni in the following sequence, and in which the electrons in the outer valence shell of the additional group elements are weakened by the influence of the nuclear charge, ionization was shown to cause an increase in potency.

USED LITERATURE

1. Hakberdiev, S. M., Talipov, S. A., Dalimov, D. N., & Ibragimov, B. T. (2013). 2, 2′-Bis {8-[(benzylamino) methylidene]-1, 6-dihydroxy-5-isopropyl-3-methylnaphthalen-7 (8H)-one}. *Acta Crystallographica Section E: Structure Reports Online*, *69*(11), o1626-o1627.
2. Хакбердиев Ш. М., Тошов Х. С. Моделирование реакции конденсации госсипола с о-толуидином //ББК 74.58 G 54. – С. 257.
3. Khamza, Toshov, Khakberdiev Shukhrat, and Khaitbaev Alisher. "X-ray structural analysis of gossypol derivatives." *Journal of Critical Reviews* 7.11 (2020): 460-463.
4. Хакбердиев, Ш. М. (2020). Бензиаминнинг госсиполли ҳосиласи синтези, тузилиши ва мис, никель, собальт тузлари билан металлокомплексларини олиш. *Science and Education*, *1*(8), 16-21.
5. Хакбердиев, Ш. М. (2020). Турли тузилишли аминларнинг госсиполи ҳосилалари синтези ва биологик фаоллиги. *Science and Education*, *1*(9).
6. Khakberdiyev, S. M. (2021). Study of the structure of supramolecular complexes of azomethine derivatives of gossipol. *Science and Education*, *2*(1), 98-102.

World Bulletin of Public Health (WBPH)
Available Online at: https://www.scholarexpress.net
Volume-16, November 2022
ISSN: 2749-3644

7. Ҳамидов С. Х., Муллажонова З. С. Қ., Хакбердиев Ш. М. Кумушнинг госсиполли комплекси ва спектрал таҳлили //Science and Education. – 2021. – Т. 2. – №. 2.
8. Хақбердиев Ш. Янги шифф асослари ва уларнинг сувда эрувчан комплекслари тузилишини ўрганиш //Журнал естественных наук. – 2021. – Т. 1. – №. 2.
9. Хамидов, С. Ҳ., & Хакбердиев, Ш. М. (2021). Бирламчи алифатик аминларнинг госсиполли ҳосилалари синтези. *Science and Education*, *2*(3), 113-118.
10. Муллажонова, З. С., Хамидов, С. Ҳ., & Хакбердиев, Ш. М. (2021). Турли усулларлар ёрдамида госсиполли комплекс таркибидан кумуш ионини аниқлаш. *Science and Education*, *2*(3), 64-70.
11. Khaitbaev A. K., Khakberdiev S. M., Toshov K. S. Isolation of Gossypol from the Bark of Cotton Roots //Annals of the Romanian Society for Cell Biology. – 2021. – С. 1069-1073.
12. Хақбердиев Ш. Госсипол ҳосилалари, металлокомплекслари синтези қилиш ва кукунли дифрактометрда ўрганиш //Журнал естественных наук. – 2021. – Т. 1. – №. 2.
13. Хақбердиев Ш. Шифф асоси ва металлокомплексларининг термик анализи //Журнал естественных наук. – 2021. – Т. 1. – №. 3.
14. Хакбердиев Ш. Синтез, строение и получение супрамолекулярных комплексов ароматических аминов с госсиполом //Журнал естественных наук. – 2021. – Т. 1. – №. 4.
15. Хакбердиев Ш. М. и др. Синтез госсипольных производных орто, мета, пара толуидина и их строение //Science and Education. – 2021. – Т. 2. – №. 10. – С. 195-200.
16. Khakberdiev, Sh M., et al. "Synthesis and structure of gossypol azomethine derivatives." *Young Scientist,(4)* (2015): 42-44.
17. Хакбердиев Ш. М. и др. 3-аминопропанол-1 билан госсиполнинг турли комплекслари синтези ва макрофаглар миқдорига таъсири //Журнал естественных наук. – 2021. – Т. 1. – №. 1.
18. Хакбердиев, Ш. М. (2021). Госсиполнинг аминопиридинлар билан синтези ва уларнинг никел тузи металлокомплексларини олиш. *Журнал естественных наук*, *3*(5), 10-15.
19. Хакбердиев, Ш., Қодир, Д., Маматова, Ф., & Муллажонова, З. (2022). Госсипол асосида ациклик аминобирикмаларнинг ҳосилалари синтези. *Журнал естественных наук*, *1*(2 (7)), 12-16.
20. Mahramovich, K. S., Sattarovna, K. F., & Farangiz, M. (2022). Synthesis of Gossipy Products of Pyrimidine Bases and Getting Their Water-Solved Complexes. *Eurasian Scientific Herald*, *8*, 118-121.
21. Mahramovich, K. S. (2022). Results of computer study of biological activity of gossipol products. *Web of Scientist: International Scientific Research Journal*, *3*(6), 1373-1378.
22. Хакбердиев, Ш., Муллажонова, З., & Маматова, Ф. (2022). Аденининнинг госсиполли ҳосиласи унинг металло ва супрамолекуляр комплексларини турли таҳлиллар асосида ўрганиш. *Журнал естественных наук*, *1*(2 (7)), 288-293.