X-RAY STRUCTURAL INVESTIGATION OF GOSSYPOL AND ITS DERIVATIVES. VIII. A NEW CLASS OF INCLUSION COMPOUNDS BASED ON DIANILINEGOSSYPOL

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We have previously reported that gossypol (GP) forms inclusion compounds (ICs) with many organic molecules [1-3]. Recently, a number of derivatives of GP possessing physiological activity have been synthesized, among which a special place is occupied by derivatives of the type of Schiff's bases [4-6]. In order to determine whether the capacity for forming ICs is retained in products of the chemical modification of GP, we have made a systematic study of adduct formation by various derivatives of GP. In the present communication we consider the preparation and identification of ICs in the case of a typical arylimine – dianilinegossypol (DAGP).

About 30 ICs of this derivative have been obtained and identified, and for 15 of them it has been possible to grow single crystals. Table 1 gives the crystallograph characteristics of these ICs. Isostructural ICs have been combined into classes. In six classes, no other isomorphous members have yet been detected. To different degrees, the polar DMFA and $CHCl_3$ give isostructural ICs, which is completely excluded in the case of GP. It must be mentioned that so far no unsolvated crystalline form of DAGP have been obtained from solutions.

The molecular complexes of DAGP crystallized in more highly symmetrical space groups than those of GP. This is a consequence of the lower tendency of DAGP to dimerize through symmetrical intermolecular hydrogen bonds, which leads to a loss of intrinsic symmetry by the molecule – twofold axes in crystalline complexes [7]. 40% of the ICs have 0.5 of a molecule in the independent part of the elementary cell. In those molecular complexes, the composition is determined by a host:guest ratio of 1:2. However, the majority of ICs the independent part of the elementary cell of which contains one host molecular have the same composition.

The next feature of the ICs of DAGP is their instability under ordinary conditions: 85% of the complexes begin to desolvate after their separation from the mother solution. The ICs under consideration are characterized by looser packing than those of GP, which leads to lower densities of the crystals.

The molecular and crystal structures of the complex of DAGP with ethyl acetate were considered in [7]. In these crystals, the DAGP has predominantly the quinoid tautomeric form, in contrast to the benzene form of GP in its various crystalline complexes [1-3]. At the present time, the interpretation of the structure of the complex of DAGP with dichloroethane, which represents the family of ICs of DAGP with nonpolar molecules having a host:guest ratio of 1:2, is being completed.

EXPERIMENTAL

The ICs of DAGP were obtained in the condensation of GP with aniline in the corresponding solvents. Single crystals were grown from more dilute solutions. To measure the crystallographic parameters of single crystals of the unstable ICs they were first placed in thin-walled quartz capillaries or were coated with a thin layer of epoxide resin. The quality of single crystals was checked in a precession x-ray camera, and the parameters were determined and refined from 15 reflections in the range of angles of 20-30° on a Syntex $P2_1$ automatic four-circle diffractometer.

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TABLE 1. Crystallographic Characteristics of ICs of DAGP

Class	Solvent	*a*	*b*	*c*	α	β	γ	*V*, Å³	Space group	Composition host: guest	Calc. density, g/cm³
		Å			degrees						
A	Chloroform	13,587 (3)	11,596 (2)	28,514 (6)	90	94,25 (2)	90	4480,3	A2/*a*	1:2	1,34
	DMFA*	13,332 (5)	11,781 (3)	28,786 (20)	90	94,47 (4)	90	4507,5	A2/*a*	1:2	1,20
B	Ethyl acetate*	18,025 (3)	10,840 (2)	25,021 (3)	90	126,36 (2)	90	3937,5	$P2_1/c$	1:1	1,25
	Methyl propionate*	18,383 (9)	10,676 (2)	25,639 (17)	90	127,48 (3)	90	3993,5	$P2_1/c$	1:1	1,26
C	Acetone	11,008 (2)	29,534 (12)	13,583 (2)	90	90	90	4415,9	P*ccn*	1:2	1,18
	Methyl ethyl ketone	10,876 (3)	29,503 (9)	14,095 (3)	90	90	90	4522,9	P*ccn*	1:2	1,19
	Acetylacetone	10,654 (3)	29,680 (9)	14,638 (5)	90	90	90	4628,5	P*ccn*	1:2	1,24
D	1,4-Dioxane*	37,713 (11)	37,717 (11)	20,247 (5)	90	90	120	24913,4	$P3_1$ or $P3_121$	1:1	1,21
E	Dichloroethane	11,996 (3)	13,647 (3)	16,793 (5)	119,76 (2)	91,07 (2)	71,74 (2)	2234,9	$P\bar{1}$	1:2	1,28
	Dibromoethane	12,391 (5)	14,153 (4)	16,005 (5)	108,31 (2)	94,23 (3)	79,15 (3)	2616,7	$P\bar{1}$	1:2	1,31
F	Benzene	12,294 (5)	12,711 (6)	29,585 (17)	90	90	91,06 (4)	4622,5	$P2_1/a$	1:2	1,18
G	Isobutyl acetate	10,883 (5)	12,385 (3)	20,637 (5)	98,36 (2)	110,32 (3)	76,18 (3)	2526,9	$P\bar{1}$	1:2	1,18
H	Methyl acrylate	16,345 (9)	10,883 (2)	14,006 (2)	90	115,30 (3)	90	2251,5	$P2_1/c$	1:2	1,24
I	Toluene	8,070 (2)	21,425 (6)	27,785 (16)	90	94,35 (4)	90	4790,2	$P2_1/n$	1:2	1,18
J	p-Chlorotoluene	10,226 (6)	13,189 (8)	18,759 (20)	90,26 (7)	93,56 (7)	107,56 (5)	2406,6	$P\bar{1}$	1:2	1,27

*ICs stable under ordinary conditions.

SUMMARY

The existence of a new class of ICs based on DAGP has been established. Single crystals have been obtained and the crystallographic characteristics of 15 ICs of this GP derivative have been determined.

LITERATURE CITED

1. B. T. Ibragimov, S. A. Talipov, G. B. Nazarov, T. F. Aripov, and A. I. Ismailov, Khim. Prir. Soedin., 663 (1984).
2. S. A. Talipov, B. T. Ibragimov, G. B. Nazarov, T. F. Aripov, and A. S. Sadykov, Khim. Prir. Soedin., 835 (1985).
3. B. T. Ibragimov, S. A. Talipov, G. B. Nazarov, R. G. Mardanov, T. F. Aripov, A. I. Ismailov, and A. S. Sadykov, Khim. Prir. Soedin., 113 (1986).
4. A. I. Ismailov, A. S. Sadykov, L. Biktimirov, S. A. Vichkanova, and A. V. Goryunova, in: Proceedings of an All-Union Scientific Conference on the Pharmacological and Clinical Study of Plant Drugs [in Russian], VILR [All-Union Institute of Medicinal Plants], Moscow (1972), p. 219.
5. Kh. L. Ziyaev, G. A. Ismailova, L. Biktimirov, N. I. Baram, and K. G. Urazmetov, in: Urgent Questions of the Transplantation of Organs and Tissues [in Russian], Fan, Tashkent (1984), p. 9.
6. N. I. Baram, L. Biktimirov, Kh. L. Ziyaev, R. Z. Paizieva, N. Mukhamedzhanov, V. I. Ananchenko, A. I. Ismailov, and A. S. Sadykov, Abstracts of Lectures of the Vth All-Union Symposium on Phenolic Compounds [in Russian], Tallin (1987), p. 21.
7. G. B. Nazarov, B. T. Ibragimov, and T. F. Aripov, Khim. Prir. Soedin., p. 661 (1988) [in this issue].

X-RAY STRUCTURAL INVESTIGATION OF GOSSYPOL AND ITS DERIVATIVES.

IX. SEMICLATHRATES OF GOSSYPOL WITH ESTERS OF ACETIC ACID

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Inclusion compounds of gossypol with a number of acetic acid esters have been obtained and have been identified by derivatography and NMR spectroscopy. An x-ray structural investigation of the structures of crystalline complexes of gossypol with ethyl acetate and butyl acetate has shown that these complexes are isostructural semiclathrates. On the basis of the structures of these two semiclathrates of gossypol, it has been concluded that esters and ketone with chain lengths of from five to seven atoms form inclusion compounds isomorphous with the semiclathrates of ethyl and butyl acetates. If the chain length is shorter or longer than that given, inclusion compounds with a different crystal structure are formed.

At the present time, inclusion compounds are being widely used in analytical chemistry and chromatography and in the fractionation of compounds of closely similar structure [1, 2]. No few compounds are known that give crystalline complexes with the inclusion of a number of comparatively small molecules [1-3]. Nevertheless, chemists continue to synthesize new substances that may prove to be "hosts" in the structure of inclusion compounds [4].

As a result of investigations performed by the methods of x-radiography, derivatography, and thermomicroscopy, we have established that gossypol, a physiologically active substance

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