Acetylation of 17α -Ethynylestra-4-ene-10ß-diol-3-one (IIc). To a suspension of 1.36 g of compound IIc in 15 ml of glacial acetic acid, at 10°C and with vigorous stirring and under a nitrogen sweep, were added successively 4.4 ml of acetic anhydride, 0.3 ml of a 4% solution of hydrogen chloride in acetic acid, and 0.3 g of anhydrous zinc chloride. After 80 min of stirring at room temperature, the precipitate completely dissolved. The stirring was continued for another 2.5 h; the solution was cooled to 8°; and dilute (1:1) hydrochloric acid (1.7 ml) was added dropwise. The mixture was stirred for 30 min and then 150 ml of cold water was added. An oil (1.48 g) was extracted with methylene chloride. It was dissolved in a mixture of hexane and benzene (2:5) and chromatographed on silica gel. Compound V (0.11 g) was washed off with benzene, mp 141-143° (from ethanol); literature data [6]: mp 143-144°; compound IV was washed off similarly, yield 0.51 g, mp 195-196° (from ethanol); it was identical with a known specimen; compound VI (0.36 g) was eluted with a mixture of benzene and ether; it had mp 175-177° (from methanol); literature data [7]: 178°.

 17α -Ethynylestradiol 3-Methyl Ether (III). A suspension of 0.8 g of compound IIc in 25 ml of methanol was heated at 50° with 0.4 g of the H⁺ form of Dowex-50 resin. After 2 h the reaction mixture was cooled and the precipitate was filtered off. It was washed several times with methylene chloride. After evaporation of the methylene chloride, there was obtained 0.43 g of compound III, mp 149-150°; literature data [5]: mp 150-151.5°.

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IODINATION OF PSEUDODIOSGENIN 0,0-DIACETATE

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We have previously studied the iodination of pseudosolasodine 0,N-diacetate. In the present paper we give the results of an investigation of the iodination of pseudodiosgenin 0,0-diacetate, an intermediate in the industrial method of cleaving diosgenin to dehydro-prenenolone acetate [1, 2].

A study of the products of the iodination of pseudodiosgenin 0,0-diacetate showed that, as in the case of pseudosolasodine diacetate, iodine-free compounds are formed and the aqueous layer has an acid reaction (pH 2.0), due to the liberation of hydriodic acid. It was found that in the iodination of (I) different compounds are formed according to the nature of the alcohol (methanol, ethanol, isopropanol) used in the reaction (Table 1). On the basis of physicochemical characteristics and the results of analysis, these compounds were assigned the structure of 23-alkoxy-3 β ,26-diacetoxyfurosta-5,20(22)-dienes (IIa-c). In the region of characteristic frequencies, the IR spectra of (IIa-c) were identical with one another and with the IR spectrum of (I). They lacked absorption bands in the 3500-3000 cm⁻¹ region but had a broad band in the 1740-1730 cm⁻¹ region characteristic for two ester groups, and a band of medium intensity at 1690 cm⁻¹ which is characteristic for a C₂₀-C₂₂ double bond in similar

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compounds. There were slight differences only in the "fingerprint" region. The PMR spectra of (IIa-c) taken in deuterochloroform had identical signals for the methyl groups in positions 10, 13, 20, and 25 and for the protons at C_3 , C_6 , C_{16} , and C_{26} (Table 2). In the PMR signal of (IIa) there was a singlet signal with an intensity of three proton units in the 3.2 ppm region, which was assigned to a methoxy group. For (IIb) a triplet was observed at 1.13 ppm and a quartet at 3.35 ppm which were assigned to an ethoxy group. For (IIIc) there were two singlet signals at 1.05 and 1.12 ppm and a septet at 3.56 ppm, which characterized an isopropoxy group. The spectra of (IIa-c) each had a multiplet signal of one proton unit in the 4.0 ppm region which was assigned to the proton on the C_{23} carbon atom to which the al-koxy groups were attached. In the mass spectra of (IIa-c), the peaks of the molecular ions were observed with mass numbers of 528, 542, and 556, respectively. The most suitable direction for their fragmentation is the elimination of the side chain with the subsequent localization of the charge on the oxygen atom of the alkoxy group as shown in the scheme below.



The subsequent decomposition of the fragment formed probably takes place through the cleavage of the $C_{13}-C_{17}$ and $C_{14}-C_{16}$ bonds in ring D and is responsible for the appearance in the spectra of the following ion peaks: m/e 125 (for IIa), m/e 139 (for IIb), and m/e 153 (for

CH=OR. In the case of (IIb) and (IIc), the subsequent elimination of ethylene

and propylene molecules, respectively, leads to the formation of an ion with m/e lll, which is absent from the spectrum of (IIa). Such fragmentation of the molecular ions and also the presence of an intensive peak of the COCH₃ ion (m/e 43) in all the spectra agree well with the proposed structure (II). It may be expected that compounds (IIa-c) are mixtures of diastereomers at C_{23} , but only for (IIb) is this confirmed by the features of the PMR spectra, where a distinct doubling of the signals of the angular methyl group at C_{13} and of the methylene group in the ethyl residue is observed.

When (I) was iodinated in ethanol, in addition to (IIb) we isolated its structural isomer -3β ,26-diacetoxy-20-ethoxyfurosta-5,22(23)-diene (IIIb). The IR spectrum of (IIIb) is similar to that of (IIb) and has two absorption bands of ester groups (1725, 1745 cm⁻¹) and an absorption band at 1690 cm⁻¹. In the PMR spectrum of (IIIb) a singlet signal of the methyl group at C₂₀ is observed in the 1.35 ppm region and a triplet one-proton signal in the 4.14 ppm region due to the proton at C₂₃ of the exocyclic C₂₂-C₂₃ double bond. A structural isomer of (IIa) - 3 β ,26-diacetoxy-20-methoxyfurosta-5,22(23)-diene (IIIa) - was isolated when (I) was iodinated in acetone and the reaction mixture was then treated with methanol. The physicochemical properties of (IIIa) confirmed its structure (Table 2).

The position of the double bond at $C_{20}-C_{22}$ for (II) and $C_{22}-C_{23}$ for (III) is also confirmed by their oxidation with sodium dichromate in acetic acid. On oxidation followed by

Com-	Melting point	n	ular om ass um)	Four (in a	Found (in %)	Calcu (in %	lated)	
	(°C)	Λf -	Molec wt. (fr the m	с	н		с	Н
lla IIb IIc IIIa IIIb	$\begin{vmatrix} 113-5\\88,5-90\\74-6\\104-6\\118-9 \end{vmatrix}$	0,81 0.88 0,90 0,88 0,90	528 542 556 —	72,73 73,10 73,48 72,40 73,61	9,13 9,40 9,49 8,86 9,34	$\begin{array}{c} C_{32}H_{48}O_{6}\\ C_{33}H_{50}O_{6}\\ C_{34}H_{52}O_{6}\\ C_{32}H_{52}O_{6}\\ C_{32}H_{45}O_{6}\\ C_{32}H_{45}O_{6}\\ C_{33}H_{50}O_{6} \end{array}$	72,69 73,03 73,34 72,69 73,03	9,15 9,28 9,42 9,15 9,28

TABLE 1. Physicochemical Characteristics of Compounds (II) and (III) $% \left(\left(1\right) \right) =\left(1\right) \left(1\right)$

<u>Note.</u> Compound (II) was crystallized from 80% acetone and compounds (IIb,c) and (IIIa,b) from methanol.



the boiling of the reaction mixture in acetic acid, the compound (II) gave dehydropregnenolone acetate (V). When (IIc) was oxidized, it was possible to isolate as an oxidation product 3β -acetoxy- 16β - $(\delta$ -acetoxy- γ -methylvaleryloxy)-23-isopropoxypregn-5-en-20-one (IVa), an analog of "diazon"* (IVb) [3]. The IR spectra of (IVa) and also that of (IVb) contained absorption bands at 1727, 1740, and 1705 cm⁻¹, which are characteristic for ester and carbonyl groups. The PMR spectrum of (IVa), similar to that of (IVb), contained the additional signals characterizing an isopropoxy group and a proton at C₂₃ (see Table 2). When (IVa) and (IVb) were boiled with acetic acid, (V) was formed. The oxidation of (IIIb) with sodium dichromate in acetic acid led to the formation of 3β -acetoxy-20-ethoxy-5-bisnorcholene 20,16lactone (VI), the ethyl derivative of a hydroxy lactone obtained by us previously [4]. The IR and PMR spectra confirmed the structure of (VI). In its IR spectra there was an absorption band at 1775 cm⁻¹ characterizing a γ -lactone system, and the PMR spectrum had a multiplet signal at 5.0 ppm, which is characteristic for a proton in position 16 of lactones of this type [4], and the signals belonging to an ethoxy group.

The formation of compounds (II) and (III) by the iodination of (I) is another interesting fact characterizing the features of the chemical behavior of the cyclic vinyl ether system of the pseudo compounds (the diacetates of pseudosolasodine and of pseudodiosgenin). In the study of the iodination of pseudosolasodine, we expressed the view that iodination takes place through the addition of iodine at the C_{20} - C_{22} double bond and is accompanied by the extremely ready splitting out of hydriodic acid and by the closure of an N-acetylpyrrolidine ring. It is probably necessary to put forward the following general scheme of the mechanism of the iodination of these compounds. Iodination begins with an electrophilic attack by the iodine of the carbon atom in position 20, where the highest electron density exists with the subsequent ejection of a proton from position 23, as a result of which a system containing iodine in an allyl position is formed. The iodine is readily split off, since this gives rise to a resonance-stabilized cation. The reaction is completed in the case of pseudosolasodine diacetate by cyclization to form an N-acetylpyrrolidine ring and in the case of pseudodiosgenin diacetate (I) by a nucleophilic attack of alkoxy anions from the alcoholic medium. In our opinion, the reaction mechanism proposed explains the unusual ease of iodination of the pseudo compounds of solasodine and diosgenin.

^{*}As in Russian original, presumably a Russian tradename for the compound concerned. Not to be confused with Diazon a proprietary name, in the West, of sulfoxone sodium - Consultants Bureau.

	C., C.,	5	H ₃			H			2H	R
punodu	angular CH ₃ 'S	at C ₂₅	at C ₂₀	OAc*	at C ₃	at C ₁₆	at C ₆	at C ₂₃	at Cz6	at C ₂₃ 0
11a	0.64, 0.98	0,86 d	1,63 \$	1,98	4,62	E	5,31 m	4,01 m	3,85 d	3,20 s
	0,64, 0,99	0,86 d	1.62 s	1,97	4,64	ш	5,31 m	4,01 m	3,87 d	1,13 tr , 3,35 m
IIIa	0,76 0.96	0.80 d 0.87 d	1,62 \$	1.97	4.68 · 4.52 m l	4.80 m	5,83 B B B B	4 ()8 m 4 15 tt	3,87 d 3,86 m	1,1 s, 1,05 s, 3,56 sep 3.06 s
qili	0,77 0,97	0,86 d	1,34 s	1,98	4,54 m	4,80 m	5,31 m	4, 14 tr	3,85 m	1,05 tr, 3,28 q
IVa Vb	1.0 1.02	0,87 d 0,86 d	2,01 s	1,97	4.50 m 4.54 m	5,51 m 5,48 m	5,51 m	4,01 m	3,86 d 3,86 d	1,05 s, 1,1 s, 3,5 m
٧I	$0.79 \ 0.96$	2	1,44 s	1,97	4,53 m	5,00 m	5,31 m	1		nume.

sep)

EXPERIMENTAL

The IR spectra were taken on a UR-10 instrument and the PMR spectra on a JNM-4H-100 instrument in deuterochloroform with tetramethylsilane as internal standard. The mass spectra were taken on an IMC-01-SG-2 mass spectrometer (JEOL), Japan, for which the authors express their thanks to Zh. K. Torosyan and A. I. Belikov of the All-Union Scientific-Research Vitamin Institute. The energy of the ionizing electrons was 70 eV. Chromatography was carried out in a thin layer of Silufol in the acetonecyclohexane (1:2) system, the spots being revealed with phosphomolybdic acid at 100°C. Preparative chromatography was performed on type L40/100 silica gel ("Chemapol").

Iodination of Pseudodiosgenin Diacetate. At room temperature, a solution of 3.0 g of iodine in 120 ml of an alcohol (methanol, ethanol, or propanol) was added to a solution of 2 g of pseudodiosgenin acetate (I) in 40 ml of the alcohol. The reaction mixture was left in the dark for 1 h, and then 150 ml of chloroform was added to the reaction mixture followed by a 5% solution of sodium thiosulfate until it had been decolorized. The organic layer was separated from the aqueous layer (pH 2.0), washed with water to neutrality, dried, and evaporated in vacuum to dryness. The oily residue was triturated with ethanol or chromatographed on silica gel. This gave the 23-alkoxy-38,26-diacetoxyfurosta-5,20(22)-dienes (IIa-c) with yields of 30-50%. When the reaction was performed in ethanol, chromatography of the products on silica gel gave (IIIb) with a yield of 30% (see Table 1).

3β,26-Diacetoxy-20-methoxyfurosta-5,22(23)-diene (IIIa). The iodination of 2 g of (I) in acetone solution was performed as described above. After the working-up procedure described, 5 ml of methanol was added to the oily residue and the mixture was left at room temperature for 3 h. Then the methanol was evaporated off to dryness and the residue was chromatographed on silica gel. A mixture of benzene and chloroform eluted 0.52 g of (IIIb) (see Table 1).

Oxidation of the 23-Alkoxy-38,26-diacetoxyfurosta-5,20(22)-dienes (IIa-c) Followed by Boiling in Acetic Acid. At 20°C, a solution of 0.08 g of sodium dichromate in 3 ml of acetic acid was added to a solution of 0.15 g of (IIa-c) in 5 ml of glacial acetic acid. The reaction mixture was stirred for 30 min, 0.05 g of sodium sulfite was added, and it was boiled for 3 h. Then it was cooled, 8 ml of water was added, and the precipitate was filtered off and was washed with 50% aqueous acetic acid and with water. This gave 0.07 g of (V), identical with an authentic sample.

 3β -Acetoxy- 16β - $(\delta$ -acetoxy- γ -methylvalervloxy)-23isopropoxypregn-5-en-20-one (IVa). The oxidation of 0.35 g of (IIc) was performed as described above. The acetic acid solution was poured into water, the mixture was neutralized with sodium bicarbonate, and the resulting suspension was extracted with benzene. The benzene extract was washed with water and evaporated to dryness. The oily residue was chromatographed on silica gel. Benzene eluted 0.05 g of (V), and benzene-chloroform eluted 0.18 g of (IVa); mp 63-65°C (from methanol).

Found, %: C 69.67; H 8.99. C34H5108. Calculated, %: C 69.47; H 8.75.

Oxidation of 3β , 26-Diacetoxy-20-ethoxyfurosta-5, 22(23)-diene (IIIb). The oxidation of 0.33 g of (IIIb) was performed as described for (IIa-c). After boiling, the reaction mixture was cooled and 8 ml of water was added to it. The oily precipitate was extracted with methylene chloride, and the extract was washed with sodium bicarbonate solution and with water, dried, and evaporated to dryness. After the residue had been triturated with ethanol, 0.1 g of (VI) was filtered off; mp 199-202°C (from ethanol). Found, %: C 72.40; H 8.88. C₂₆H₃₈O₅. Calculated, %: C 72.53; H 8.89. IR spectrum: 1775 cm⁻¹ (lactone CO), 1738 cm⁻¹ (ester CO).

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USE OF MECHANIZED PLATE FILTERS FOR THE SEPARATION OF PRECIPITATES IN THE PRODUCTION OF ANTIBIOTICS

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One of the methods of mechanizing filtration processes in the production of antibiotics is the use of plate filters working under pressure [1, 2]. Filters of this type are used in various branches of industry for the separation of comparatively dilute suspensions [3]. The use of such filters abroad in the pharmaceutical industry, particularly in the production of penicillin and streptomycin and also of synthetic pharmaceutical chemicals and steroids, is known [2]. Recently, many design developments directed to the complete automation of the working of filters, the improvement of individual parts, and the specialization of filters as applied to concrete technological processes have been proposed [3-9]. The output of plate filters has been substantially increased in recent years both in the USSR and abroad [3, 10].

Various constructional modifications of plate filters are marketed: with horizontal and vertical plate elements, with horizontal and vertical bodies, and with various devices for collecting and discharging the precipitate and for regenerating the fabric [11-13]. The dimensions of the filter units marketed vary: from laboratory and pilot-plant models with filtration surface of $0.2-2 \text{ m}^2$ to large industrial filters with surfaces of 250 m² and more [11-13]. The domestic chemical engineering industry is also a large producer of filters with plate elements of various types with filtering surfaces of from 10 to 125 m² [11-14]. We have investigated the possibility of using plate filters for the separation of precipitates of impurities from the native solutions obtained after the filtration of the culture liquids of the producing agents of penicillin and tetracycline. The native solutions after the separation of the mycelium were treated in order to coagulate colloidal and to precipitate dissolved impurities [15, 16]. The characteristics of the suspensions obtained in this way are given in Table 1.

DESCRIPTION OF THE EXPERIMENTAL FILTERS

The investigations were performed using filters of two types: with horizontal and with vertical plate elements. The horizontal plate filter (Fig. 1) with a surface of 0.12 m^2 of

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