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PERFLUOROALKYL ESTERS OF STEROLS AND BILE ACIDS

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SUMMARY

A series of mono-, bis-, and tris-perfluorooctanoyloxy derivatives of sterols and bile acids were synthesized. To synthesize tris(perfluorooctanoyloxy) steroids it was necessary to use 4-dimethylaminopyridine (DMAP) as a catalyst. Without DMAP catalyst the hydroxyl group at C-12 remained unreacted. The compounds obtained are intended for testing as co-emulsifying agents for synthetic blood formulations.

INTRODUCTION

In our continuing studies on perfluoroalkyl-substituted steroids and their derivatives [1], we wish to report on the synthesis of perfluoroalkyl esters of sterols and bile acids. Perfluoroalkyl esters of steroids are desired for testing as co-emulsifying agents in fluorocarbon-based blood substitutes (*synthetic blood*) [2-5].

Heptafluorobutyrate derivatives of various sterols and bile acids have been reported in the literature and have been studied extensively for their gas chromatographic and mass spectrometric properties [6-9]. The conversion of sterols and bile acids to these derivatives has been used as a probe for the determination and quantitative assay of bile acids and sterols [10]. The synthesis of steroidal esters with a long perfluoroalkyl chain has been limited to cholesteryl mono-perfluoroalkane hexanoate, heptanoate, and octanoate [11]. These compounds were prepared by Murza and co-workers for study of their liquid-crystal properties. Although much valuable data has been accumulated on heptafluorobutyrate derivatives [12-15], the data for other steroidal perfluoro-

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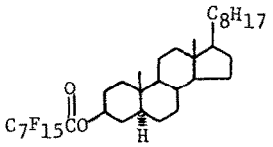
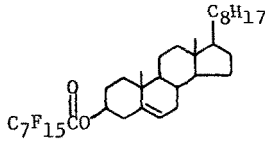
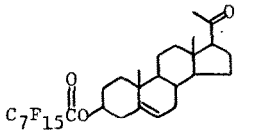
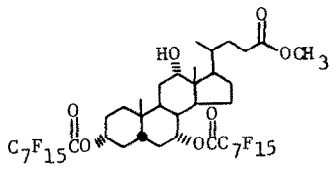
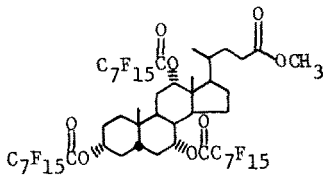
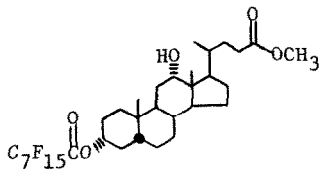
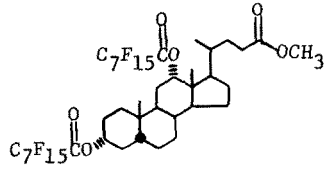
TABLE 1

Product	Structure	mp (°C)	yield (%)	^{1}H NMR
2		84-85	89.2	C_3-H, δ4.85
3		101-102.5	79.0	C_3-H, δ4.82
4		114-115.5	84.8	C_3-H, δ4.83
6		oil	78.3	C_3-H, δ4.73 C_7-H, δ5.20 C_{12}-H, δ3.92
7		66.5-68.0	80.9	C_3-H, δ4.73 C_7-H, δ5.10 C_{12}-H, δ5.26
9		94.5-96	75.1	C_3-H, δ4.83 C_{12}-H, δ3.89
10		48.5-50.0	69.0	C_3-H, δ4.82 C_{12}-H, δ5.25

alkane carboxylates is limited. In this paper we present an improved synthesis of mono-, bis-, and tris-perfluorocarboxylic acid esters of steroids (Table 1) and provide information on the characterization of above derivatives, using ^{1}H NMR, ^{19}F NMR, IR, and elementary analysis.

RESULTS AND DISCUSSION

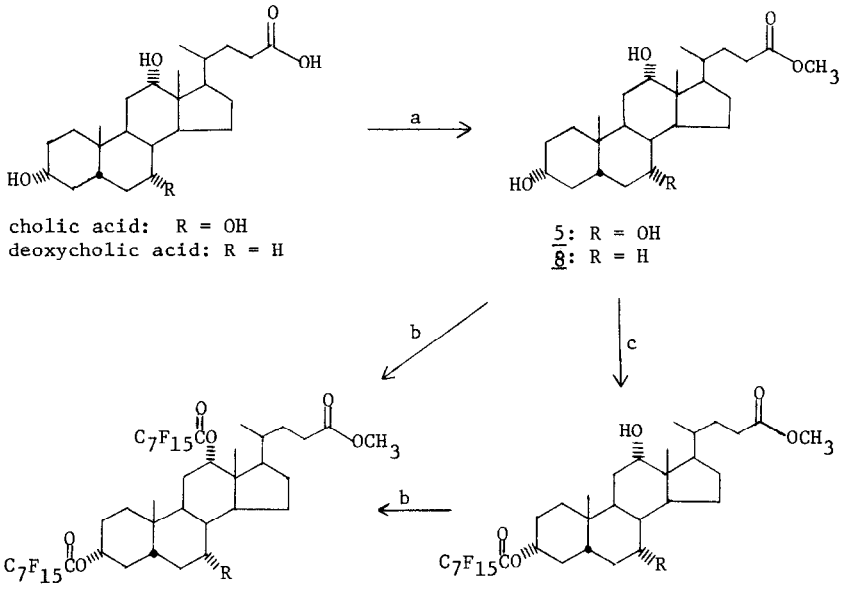
Literature procedures for preparation of perfluorocarboxylic acid esters were unsatisfactory for our purposes [6-9]. Use of the acid anhydride, perfluorooctanoic acid anyhydride, would be unacceptably expensive since two moles of perfluorocarboxylic acid are required to give one mole of ester. The literature preparation of perfluorooctanoyl chloride for subsequent acylation of the steroids was unacceptable because phosphorous pentachloride is required which leads to difficult separation problems when run on a small scale [16]. For this reason we developed a method for the synthesis of longer chain perfluorocarboxylic acid chlorides using thionyl chloride. We found that heating perfluorooctanoic acid in thionyl chloride under reflux for 4 days was convenient for preparing small amounts of perfluorooctanoyl chloride. Excess thionyl chloride was removed by distillation to give crude perfluorooctanoyl chloride (1) in 93% yield. Crude perfluorooctanoyl chloride was pure enough to use in subsequent esterification reactions and was identical in all respects with perfluorooctanoyl chloride purchased from PCR Research Chemical Inc.

The reaction of 5α-cholestan-3β-ol with a slight excess of perfluorooctanoyl chloride (1) in a 5% solution of triethylamine (TEA) in dichloromethane at room temperature gave 5α-cholestan-3β-ol pentadecafluorooctanoate (2) in 85% yield. However, when a catalytic amount of 4-dimethylaminopyridine (DMAP) was added to TEA, a much faster reaction occurred, and product 2 was obtained in a 89% yield. Similarly with DMAP, cholest-5-ene-3β-ol pentadecafluorooctanoate (3) and pregn-5-ene-3β-ol-20-one pentadecafluorooctanoate (4) were obtained in 79% and 85% yields, respectively. All analytical data obtained on compounds 2, 3 and 4 were consistent with the structures assigned.

The synthesis of perfluoroalkyl esters of bile acids was carried out in two steps (Scheme 1). In the first step the acid function at C-23 was converted to the methyl ester by stirring the methanolic solution of

the bile acid with dimethoxypropane and conc. HCl. The methyl esters 5 and 8 were isolated in 96% and 71% yields, respectively. In the next step the methyl esters 5 and 8 were converted in the presence of DMAP to the corresponding perfluorooctanoyl esters 7 and 10 in 81% and 69% yields, respectively. When the reaction was carried out in the absence of DMAP, however, no reaction at C_{12}-OH was observed. The position of the reaction site was easily established by ^1H NMR.

Reaction of 5 or 8 with 1 in the presence of TEA or pyridine gave 6 and 9, respectively, as indicated in Scheme 1. Again, all analytical data obtained (IR, ^1H NMR, ^{19}F NMR, elemental) was in agreement with the assigned structures. Compounds 6 and 9 were subsequently converted in the presence of DMAP to 7 and 10 in 62% and 65% yields, respectively.



cholic acid: R = OH
deoxycholic acid: R = H

5: R = OH
8: R = H

7: R = $O_2CC_7F_{15}$
10: R = H

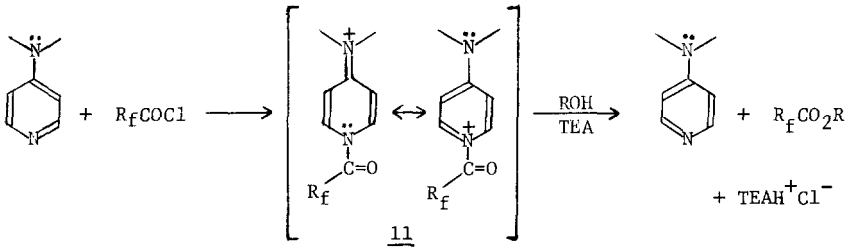
6: R = $O_2CC_7F_{15}$
9: R = H

(a) CH_3OH/DMP/HCl/25 °C (b) $C_7F_{15}COCl$/TEA/DMAP/CH_2Cl_2/25 °C

(c) $C_7F_{15}COCl$/TEA or pyridine/CH_2Cl_2/25°C

Scheme 1

The use of DMAP as a catalyst to promote acylation of hindered alcohols has been well demonstrated in the literature [17]. Its superiority to other bases, such as TEA and pyridine, was again demonstrated in our reactions. The hindered C_{12}-OH, which did not undergo esterification in the presence of TEA or pyridine, readily underwent esterification when DMAP was added. This was indicated by the conversions of 5 to 7, 6 to 7, 8 to 10, and 9 to 10. Although no study on the mechanistic aspect of DMAP-catalysis has been done in our lab, there is sufficient evidence in the literature [17] to suggest that the reaction proceeds via an N-acylpyridinium salt (11). The intermediate N-acylpyridinium salt 11 then undergoes nucleophilic displacement at the acylcarbon by the alcohol to give the ester (Scheme 2). When DMAP was replaced by 4-pyrrolidinopyridine the same results were obtained. This indicates that the catalytic activity is associated with 4-dialkylaminopyridines in general.



ROH = sterol or bile acid; TEA = triethylamine; $R_f = C_7F_{15}$

Scheme 2

The compounds obtained above are being tested as co-emulsifiers for fluorocarbons in water. Results will be reported at a later date. Compound 7 is currently under investigation by Laub and co-workers as a potential stationary phase support for gas-liquid chromatography.

EXPERIMENTAL

Melting points were determined on a Fisher-Johns melting point apparatus and are uncorrected. Infrared spectra (IR) were obtained on a Perkin-Elmer Model 337 Grating Spectrophotometer. Only principal, sharply defined peaks are reported. Proton-nuclear-magnetic resonance spectra (^{1}H NMR) were recorded on a Varian EM-390, 90 MHz, NMR Spectrometer, using tetramethylsilane as an internal standard. The ^{19}F NMR spectra were obtained on a JEOL JNM-PS-100, high resolution NMR Spectrometer. Chemical shifts were recorded in δ units relative to $CFCl_3$ as the reference. Thin-layer chromatography (TLC) was performed on precoated TLC plates (silica gel-60, F-254, layer thickness 0.2 mm) manufactured by E. Merck and Co. Elemental analyses were carried out by Galbraith Laboratories Inc. Solvents used were ACS grade and were distilled just prior to use. Chloroform and dichloromethane were distilled from P_2O_5. Triethylamine and pyridine were dried and distilled over CaH_2. 4-Dimethylaminopyridine (DMAP) and 4-pyrrolidinopyridine (4-PPY) were purchased from Aldrich Chemical Co.; perfluorooctanoyl chloride and perfluorooctanoic acid were purchased from PCR Research Chemical Inc. The term 'brine' corresponds to a saturated sodium chloride solution in water. The apparatus was dried overnight in an oven, assembled, flame dried, then allowed to cool under a stream of nitrogen or argon.

Pentadecafluorooctanoyl chloride (1)

A 2-necked, round-bottomed flask equipped with a condenser, a magnetic stirring bar and a heating mantle was charged with 4.0 gm (9.7 mmol) of perfluorooctanoic acid and 5 mL of thionyl chloride. The mixture was heated under reflux for 4 days to give a heterogenous mixture consisting of two phases. The top thionyl chloride phase was removed by distillation to leave 3.9 gm (93%) of crude 1. The crude perfluorooctanoyl chloride was used in the subsequent esterification reaction without further purification. The infrared spectrum of 1 showed the C=O and O-H bands of perfluorooctanoic acid had disappeared and were replaced by a new strong carbonyl absorption at 1800 cm^{-1}.

5α-Cholestan-3β-ol pentadecafluorooctanoate (2)

A 3-necked, round-bottomed flask equipped with a magnetic stirring bar, a nitrogen inlet/outlet and rubber septums was charged with 6.00 gm (15.5 mmol) of 5α-cholestan-3β-ol, 100 mg (0.820 mmol) of DMAP, 4.40 mL (3.19 gm, 31.5 mmol) of triethylamine and 80 mL of dichloromethane. To this stirred mixture, 4.0 mL (7.2 gm, 17 mmol) of 1 was added dropwise, over 10 minutes by a syringe. The progress of the reaction was monitored by TLC. After 2 hours of stirring at room temperature, the reaction mixture was transferred to a round-bottomed flask and the solvent evaporated under reduced pressure. The resulting residue was partitioned between equal volumes of 5% HCl and diethyl ether. The organic layer was separated and the aqueous layer further extracted with diethyl ether (2 x 100 mL). The ethereal layers were combined and washed with 5% HCl (2 x 150 mL), brine (2 x 150 mL), 5% $NaHCO_3$ (1 x 200 mL), and brine (2 x 200 mL). The organic layer was dried ($MgSO_4$), filtered and concentrated under reduced pressure to give 12.2 gm of a yellow solid. The crude product was dissolved in methanol/diethyl ether at room temperature and allowed to stand for 2 days. As diethyl ether evaporated, 2 crystallized from solution as white needles (10.8 gm, 89.2%): mp. 84-85°C; TLC ($CHCl_3$): R_F 0.60; IR (KBr): 2950, 2850, 1780, 1280-1170, 1090 and 1020 cm^{-1}; ^1H NMR ($CDCl_3$): δ4.85 (m, 1H, C_3-H), δ0.83 (s, C_{19}-H_3) and δ0.63 (s, C_{18}-H_3); ^{19}F NMR ($CDCl_3$): δ81.2 (CF_3CF_2-, 3F), δ118.8 (-OCOCF_2, 2F), δ122-122.8 (-CF_2-, 8F) and δ126.4 (CF_3CF_2-, 2F).

Anal. Calcd. for $C_{35}H_{47}F_{15}O_2$: C, 53.6; H, 6.0; F, 36.3

Found: C, 53.9; H, 6.2; F, 36.2

Cholest-5-ene-3β-ol pentadecafluorooctanoate (3)

In a manner similar to that described above, a solution of cholest-5-ene-3β-ol (0.500 gm, 1.29 mmol), DMAP (0.200 gm, 1.64 mmol), and triethylamine (0.40 mL, 0.29 gm, 2.9 mmol) in 11 mL of dichloromethane was reacted with 0.40 mL (0.67 gm, 1.7 mmol) of perfluorooctanoyl chloride (1). The mixture was stirred at room temperature for 30 minutes. The work-up, as described for 2, followed by crystallization of the residue

from acetone/water gave 0.810 gm (79.0%) of 3 as white needles: mp. 101-102.5°C (lit. mp. [11] 104°C); TLC ($CHCl_3$): R_F 0.61; IR (KBr): 3010, 2950, 1770, 1270-1170, 1140 and 1020 cm^{-1}; ^1H NMR ($CDCl_3$): δ5.38 (d, J = 5.25 Hz, 1H, C_6-H), δ4.82 (m, 1H, C_3-H) and δ2.41 (d, J = 7.5 Hz, 2H, C_4-H_2); ^{19}F NMR ($CDCl_3$): δ81.2 (CF_3CF_2-, 3F), δ118.8 (-OCOCF_2, 2F), δ122-122.8 (-CF_2-, 8F) and δ126.4 (CF_3CF_2-, 2F).

Pregn-5-ene-3β-ol-20-one pentadecafluorooctanoate (4)

In a manner similar to that described for 2, a solution of pregn-5-ene-3β-ol-20-one (0.550 gm, 1.74 mmol), triethylamine (0.57 mL, 0.42 gm, 4.2 mmol), and DMAP (145 mg, 1.18 mmol) in 10 mL of dichloromethane was reacted with 0.50 mL (0.90 gm, 2.1 mmol) of perfluorooctanoyl chloride. The reaction mixture was stirred at room temperature for 3 hours and was worked-up as described for 2. Recrystallization of crude product from methanol gave 1.05 gm (84.8%) of 4 as a white crystalline solid: mp. 114-115.5°C; TLC ($CHCl_3$): R_F 0.47; IR (KBr) 2970, 2850, 1780, 1705, 1270-1160, 1150 and 1020 cm^{-1}; ^1H NMR ($CDCl_3$): δ5.33 (d, J = 3.0 Hz, 1H, C_6-H), δ4.83 (m, 1H, C_3-H), δ2.40 (d, J = 7.5 Hz, 2H, C_4-H_2), δ2.10 (s, 3H, C_{21}-H_3), δ1.0 (s, C_{19}-H_3) and δ0.63 (s, C_{18}-H_3); ^{19}F NMR ($CDCl_3$): δ81.2 (CF_3CF_2, 3F), δ118.8 (-OCOCF_2, 2F), δ122-122.8 (-CF_2-, 8F) and δ126.4 (CF_3CF_2-, 2F).

Anal. Calcd. for $C_{29}H_{31}F_{15}O_3$: C, 48.9; H, 4.4; F, 40.0
Found: C, 49.0; H, 4.4; F, 40.2

Methyl cholate (5)

A solution of 10.0 gm (24.5 mmol) cholic acid in 75 mL of methanol and 37 mL of 2,2-dimethoxypropane (DMP) was treated with 2.0 mL of conc. HCl over a period of 2 minutes and stirred at room temperature for 20 hours to give after work up 11.0 gm of crude methyl cholate. Crystallization from methanol/water provided 10.1 gm (96.5%) of 5 as a white crystalline solid: mp 154.5-155.5°C (lit. mp [18] 155-156°C); IR (KBr):

3350, 2925, 2850, 1735, 1220, 1170, 1080 and 1030 cm^{-1}; ^1H NMR ($CDCl_3$): δ3.82 (s, 1H, C_{12}-H), δ3.58 (s, 3H, OCH_3), δ3.38 (s, 1H, C_7-H) and δ2.80 (m, 1H, C_3-H).

Methyl 12α-hydroxy-3α,7α-bis(pentadecafluorooctanoyloxy)-5β-cholan-24-oate (6)

A 50-mL, 3-necked, round-bottomed flask, equipped with a condenser, a magnetic stirring bar, rubber septums, and a nitrogen inlet/outlet was charged with 1.10 gm (2.60 mmol) of methyl cholate, 0.68 mL (0.67 gm, 8.4 mmol) of pyridine and 10 mL of chloroform. Perfluorooctanoyl chloride (2.0 mL, 3.6 gm, 8.3 mmol) was added dropwise by a syringe over a period of 13 minutes and the resulting mixture was stirred at room temperature for 6 hours and then heated under reflux for 1 hour. The work-up, as described for 2, followed by chromatography of the residue over silica gel, using $CHCl_3$ as an eluent, afforded 2.47 gm (78.3%) of 6 as an opaque, viscous oil: TLC ($CHCl_3$): R_F 0.36; IR (thin film): 3500, 2950, 2870, 1775, 1735, 1270-1160, 1140 and 1080 cm^{-1}; ^1H NMR ($CDCl_3$): δ5.20 (s, 1H, C_7-H), δ4.73 (m, 1H, C_3-H), δ3.92 (s, 1H, C_{12}-H), δ3.59 (s, 3H, OCH_3), δ0.94 (d, 3H, C_{21}-H_3), δ0.81 (s, 3H, C_{19}-H_3) and δ0.69 (s, 3H, C_{18}-H_3); ^{19}F NMR ($CDCl_3$): δ81.8 (CF_3CF_2-, 6F), δ118.2 (C_7-$OCOCF_2$, 2F), δ119.2 (C_3-$OCOCF_2$, 2F), δ122.4 -123.2 (-CF_2-, 16F) and δ126.8 (CF_3CF_2-, 4F).

Methyl 3α,7α,12α-tris(pentadecafluorooctanoyloxy)-5β-cholan-24-oate (7)

(1) Procedure-A

A 100-mL, 3-necked, round-bottomed flask equipped with a nitrogen inlet/outlet, a magnetic stirring bar and rubber septums was charged with 1.95 gm (4.61 mmol) of methyl cholate, 2.45 gm (20.1 mmol) of DMAP, 2.70 mL (1.96 gm, 19.4 mmol) of triethylamine and 50 mL of HPLC-grade dichloromethane. Perfluorooctanoyl chloride (4.60 mL, 8.28 gm, 19.1 mmol) was added dropwise, via a syringe to the stirred mixture under

nitrogen over a period of 25 minutes. The mixture was stirred at room temperature under nitrogen for 48 hours. The progress of the reaction was monitored by TLC. When all the starting material had been consumed, the brownish-yellow mixture was transferred to a 250-mL round-bottomed flask and the solvent removed under reduced pressure. The residue was partitioned between equal volumes of diethyl ether and 0.5N HCl. The organic layer was separated and the aqueous layer extracted with diethyl ether (2 x 50 mL). The combined ethereal layers extracts were washed with 0.5N HCl (1 x 100 mL), 10% $NaHCO_3$ (1 x 100 mL), and brine (2 x 100 mL). The organic layer was dried ($MgSO_4$), filtered and concentrated under reduced pressure to give 7.4 gm (99%) of crude 7 (homogeneous by TLC) as a pale yellow, waxy solid. The waxy residue was dissolved in minimum methanol/diethyl ether at room temperature and allowed to stand for 5 days. As diethyl ether slowly evaporated, 7 crystallized from solution as white needles. Filtration, followed by cold methanol wash, gave 6.00 gm (80.9%) of pure 7. An analytical sample was prepared by repeated recrystallization from methanol/diethyl ether: mp. 66.5-68°C; TLC ($CHCl_3$): R_F 0.50; IR (KBr): 2950, 2875, 1782, 1727, 1270-1160, 1145 and 1010 cm^{-1}; ^1H NMR ($CDCl_3$): δ5.26 (s, 1H, C_{12}-H), δ5.10 (s, 1H, C_7-H), δ4.73 (m, 1H, C_3-H), δ3.56 (s, 3H, OCH_3), δ0.96 (s, C_{19}-H_3), δ0.83 (d, C_{21}-H_3) and δ0.78 (s, C_{18}-H_3); ^{19}F NMR ($CDCl_3$): δ81.8 (CF_3CF_2-, 9F), δ118.2 (C_7- and C_{12}-OCOCF_2, 4F), δ119.0 (C_3-OCOCF_2, 2F), δ122.2-122.4 (-CF_2-, 24F) and δ126.6 (CF_3CF_2-, 6F).

Anal. Calcd. for $C_{49}H_{39}F_{35}O_8$: C, 36.5; H, 2.4; F, 53.1

Found: C, 36.7; H, 2.6; F, 52.9

(2) Procedure-B

In a manner similar to that described for 7 (procedure-A), a solution of 6 (3.20 gm, 2.63 mmol) and 4-PPY (0.49 gm, 2.7 mmol) in 10 mL of dichloromethane was reacted with 0.75 mL (1.4 gm, 3.1 mmol) of perfluorooctanoyl chloride. A mild exothermic reaction occurred (dichloromethane boiled) and a white insoluble precipitate of amine hydrochloride formed. The mixture was stirred at room temperature overnight. The work-up, as described for 7 (procedure-A), followed by crystallization of the

yellow, waxy residue from methanol/diethyl ether (as described previously) gave 2.65 gm (62.4%) of pure 7: mp. 66-67.5°C. The product isolated by this method was found identical in all respects (TLC, IR, ^{1}H NMR, and ^{19}F NMR) to the product isolated in procedure-A.

Methyl deoxycholate (8)

In a manner similar to that described for 5, 5.00 gm (12.7 mmol) of deoxycholic acid afforded 3.60 gm (70.6%) of 8 as a white crystalline solid: mp. 93-94°C (lit. mp. [19] 94-95°C); IR (KBr): 3400, 2935, 2855, 1740, 1250, 1170 and 1040 cm^{-1}; ^{1}H NMR ($CDCl_3$): δ3.95 (s, 1H, C_{12}-H), δ3.65 (s, 3H, OCH_3) and δ3.60 (m, 1H, C_3-H).

Methyl 12α-hydroxy-3α-(pentadecafluorooctanoyloxy)-5β-cholan-24-oate (9)

By following the procedure described for preparation of 7 (procedure-A), a solution of 0.500 gm (1.23 mmol) of 8 and 0.50 mL (0.36 gm, 3.6 mmol) of triethylamine in 10 mL of HPLC-grade dichloromethane was reacted with 0.70 mL (1.3 gm, 2.9 mmol) of 1. The mixture was stirred at room temperature, under argon, for 5 hours. The work-up, as described for 7 (procedure-A), followed by chromatography of the residue (0.85 gm, yellow viscous oil) over silica gel, using $CHCl_3$ as an eluent, gave 0.740 gm (75.1%) of 9 as a colorless paste. Recrystallization from methanol/diethyl ether/water gave pure 9 as white needles: mp 94.5-96°C; TLC ($CHCl_3$): R_F 0.40; IR (thin film): 3500, 2950, 2850, 1780, 1735, 1150-1260, 1140 and 1080 cm^{-1}; ^{1}H NMR ($CDCl_3$): δ4.80 (m, 1H, C_3-H), δ3.92 (s, 1H, C_{12}-H) and δ3.50 (s, 3H, OCH_3); ^{19}F NMR ($CDCl_3$): δ81.8 (CF_3CF_2-, 3F), δ119.2 (C_3-$OCOCF_2$, 2F), δ121.6-122.6 (-CF_2-, 8F) and δ126.4(CF_3CF_2-, 2F).

Anal. Calcd. for $C_{33}H_{41}F_{15}O_5$: C, 49.4; H, 5.2; F, 35.5

Found: C, 49.6; H, 5.3; F, 35.4

Methyl 3α,12α-bis(pentadecafluorooctanoyloxy)-5β-cholan-24-oate (10)

(1) Procedure-A

The procedure described for preparation of 7 (procedure-A) was followed. A solution of 0.500 gm (1.23 mmol) 8, 0.340 gm (2.78 mmol) DMAP, and 0.36 mL (0.26 gm, 2.6 mmol) triethylamine in 10 mL of dichloromethane was treated with 0.65 mL (1.2 gm, 2.7 mmol) of perfluorooctanoyl chloride over a period of 5 minutes. The mixture was stirred at room temperature until starting material was consumed (25 minutes), as indicated by TLC analysis. The work-up, as described for 7, (procedure-A), followed by crystallization of the residue (1.28 gm, 86.7%, opaque viscous oil) from n-propyl alcohol/diethyl ether provided 1.02 gm (69.0%) of pure 10 as white needles. If the crystallization of the residue is unsuccessful, the crude product can be purified by chromatography (silica gel, 90% CH_2Cl_2/hexane) to give pure 10: mp. 48.5-50°C; TLC ($CHCl_3$): R_F 0.55; IR (KBr): 2950, 1780, 1730, 1270-1170, 1150 and 1020 cm^{-1}; ^1H NMR ($CDCl_3$): δ5.25 (s, 1H, C_{12}-H), δ4.82 (m, 1H, C_3-H), δ3.56 (s, 3H, OCH_3), δ0.89 (s, C_{19}-H_3), δ0.83 (d, C_{21}-H_3) and δ0.73 (s, C_{18}-H_3); ^{19}F NMR ($CDCl_3$): δ81.8 (CF_3CF_2-, 6F), δ117.8 (C_{12}-OCOCF_2, 2F), δ119.2 (C_3-OCOCF_2, 2F), δ121.8-123.0 (-CF_2-, 16F) and δ126.6 (CF_3CF_2-, 4F).

Anal. Calcd for $C_{41}H_{40}F_{30}O_6$: C, 41.1; H, 3.4; F, 47.6

Found: C, 41.3; H, 3.4; F, 47.5

(2) Procedure-B

In a 25-mL, 2-necked, round-bottomed flask fitted with rubber septums, a magnetic stirring bar and a nitrogen inlet/outlet were placed 0.600 gm (0.748 mmol) of 9, 100 mg (0.818 mmol) of DMAP, 0.12 mL (0.087 gm, 0.86 mmol) of triethylamine, and 10 mL of HPLC-grade dichloromethane. Perfluorooctanoyl chloride (0.20 mL, 0.36 gm, 0.83 mmol) was added and the mixture stirred at room temperature, under argon for 12 hours. The work-up, as described for 7, (procedure-A), followed by crystallization of the crude product from n-propyl alcohol/diethyl ether gave 0.585 gm

(65.0%) of 10: mp. 48.0-50°C. The product obtained was found indistinguishable from the product obtained in procedure-A (TLC, IR, ^{1}H and ^{19}F NMR).

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