S U M M A R Y

The work embodied in the present thesis has been divided into three parts:

A. The first part (Part I) describes the reductive action of potassium hydroxide in diethylene glycol on Ketones.

B. The second part (Part II) consists of the action of N-bromo-succinimide on steroid and triterpenoids.

C. The third part (Part III) deals with the investigation on the bark of Gyanocordia odorata and isolation of two new triterpenes . 3β-O-acetyl odollactone $C_{32}H_{50}O_4$, m.p. 302-3° and 3β-odollactone $C_{30}H_{48}O_3$, m.p. 310°, $[\alpha]_D$ - 2.48°, along with β-sitosterol and trichadenic acid. It also consists the reinvestigation on the structure establishment of odolactone by chemical methods.

A. PART I:

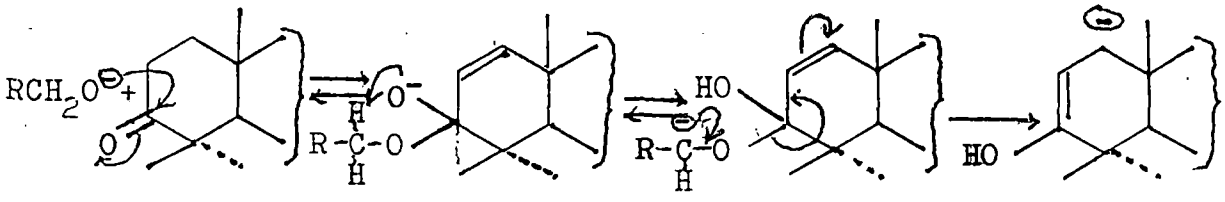
Chapter II describes the reductive action of potassium hydroxide in diethylene glycol on triterpenoid ketones and non-terpenoid ketone. The keto compounds which were reduced by potassium hydroxide/diethylene glycol are given below.

Ketones	Products	m.p.
Methyl Trichadonic acid	Trichadenic acid (5a) and trichadenic acid 5b.	289-90° 334-35°
Friedelin	Friedelanol and epi friedelanol	315-16° 278-80°
Moretenone	Moretenol and epi moretenol	228-30° 223-24°

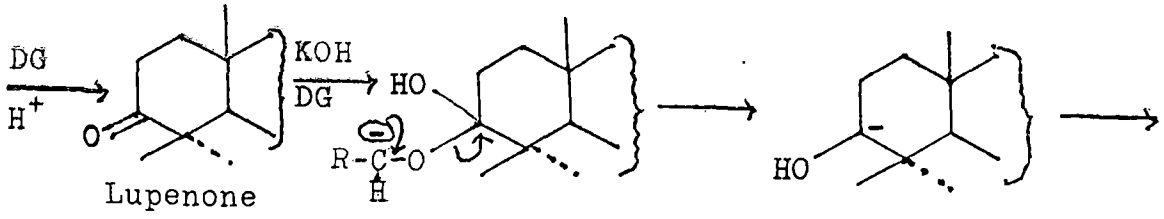
Ketones	Products	m.p.
Taraxerone	Taraxerol and	278-79°
	epitaraxerol	262-64°
β-amyrone	β-amyrin and	237-38°
	epi-β-amyrin	220-22°
Lupenone	Lupeol ,and	214-16°
	epi-lupeol	200-201°
Glochidone	lupeol	214-16°
	epi-lupeol & lupenone	200-201°
		168-69°
Benzophenone	Benzhydrol	67-68°

The identity of the products formed were established by m.m.p., Co-TLC, Co-IR with the most probable mechanism for this reduction has been suggested to follow the route as in the scheme I.

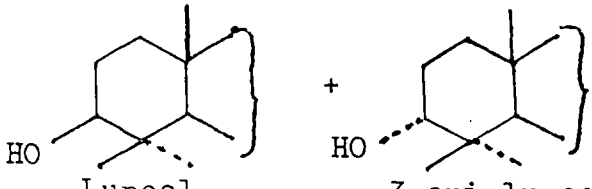
Scheme I



Glochidone



Lupenone



Lupeol + 3-epi-lupeol

The above findings has been published in Tetrahedron, 41, 2513 (1985).

Chapter III deals the reaction of choleterol with benzophenone in presence of potassium hydroxide in diethylene glycol. It gives two products 4 & 6.

The compound 4 was identified as cholesta-3,5-diene $C_{27}H_{44}$ having m.p. 79-80°, $[\alpha]_D$ - 105°. Its UV spectrum displayed absorption at 234 nm. In its mass spectrum compound 4 exhibited peaks at m/z 358 $(M)^+$.

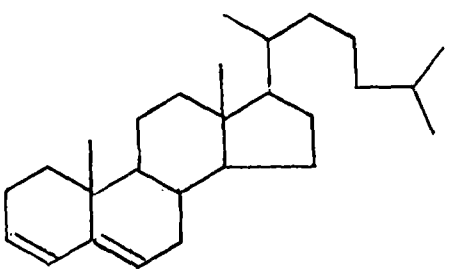
The compound 6 was analysed for $C_{40}H_{52}O_2$ having m.p. 106-07°. The compound 6 was identified as cholesta-5, 7-dien-3, 6-diol benzophenide.

Spectroscopic analysis of Cholesta-5, 7-diene-3, 6 diol benzophenide (6)

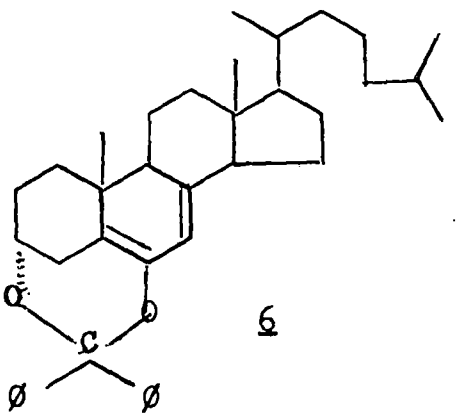
The compound 6 exhibited the following spectral data. IR ν_{max}^{nujol} cm^{-1}: 1640 and 1220 (vinyl ether); 1140, 785, 780, 770, 715 and 710 (benzene nucleus); UV (n-hexane): λ_{max} 268 nm (ϵ, 9000); Mass: 564 $[M]^+$; ^1H NMR ($CDCl_3$ with TMS, ppm): 0.69, 1.02 (2 tert Me), 0.86, 0.87, 0.97 (3 sec Me), 3.69 (a proton geminal to ether oxygen), 6.50 (olefinic proton), 7.2, 7.45 (phenyl protons); ^{13}C NMR signal assigned according to carbon atoms 1 to 27 ($CDCl_3$ with TMS, ppm): 37.1(t), 28.8(t), 82.6(d), 37.1(t), 137.9(s), 126.3(s), 144.1(d), 141.1(s), 50.1(d), 36.7(s), 21.0(t), 39.4(t), 42.3(s), 56.2(d), 24.3(t), 28.2(t), 56.8(d), 11.9(q), 18.7(q), 35.8(q), 19.4(q), 36.2(t), 23.8(t), 39.8(t), 28.0(d), 22.6(q), 22.8(q), [140.2(2s), 122.3(1d),

126.2(1d), 127.8(d), 128.2(d), 128.5(d), 129.9(d)_7 (aromatic carbons), 120.0 (s) [carbon linked with two oxygen atoms_7.

The structure of Compound 4 & 6 are represented as:



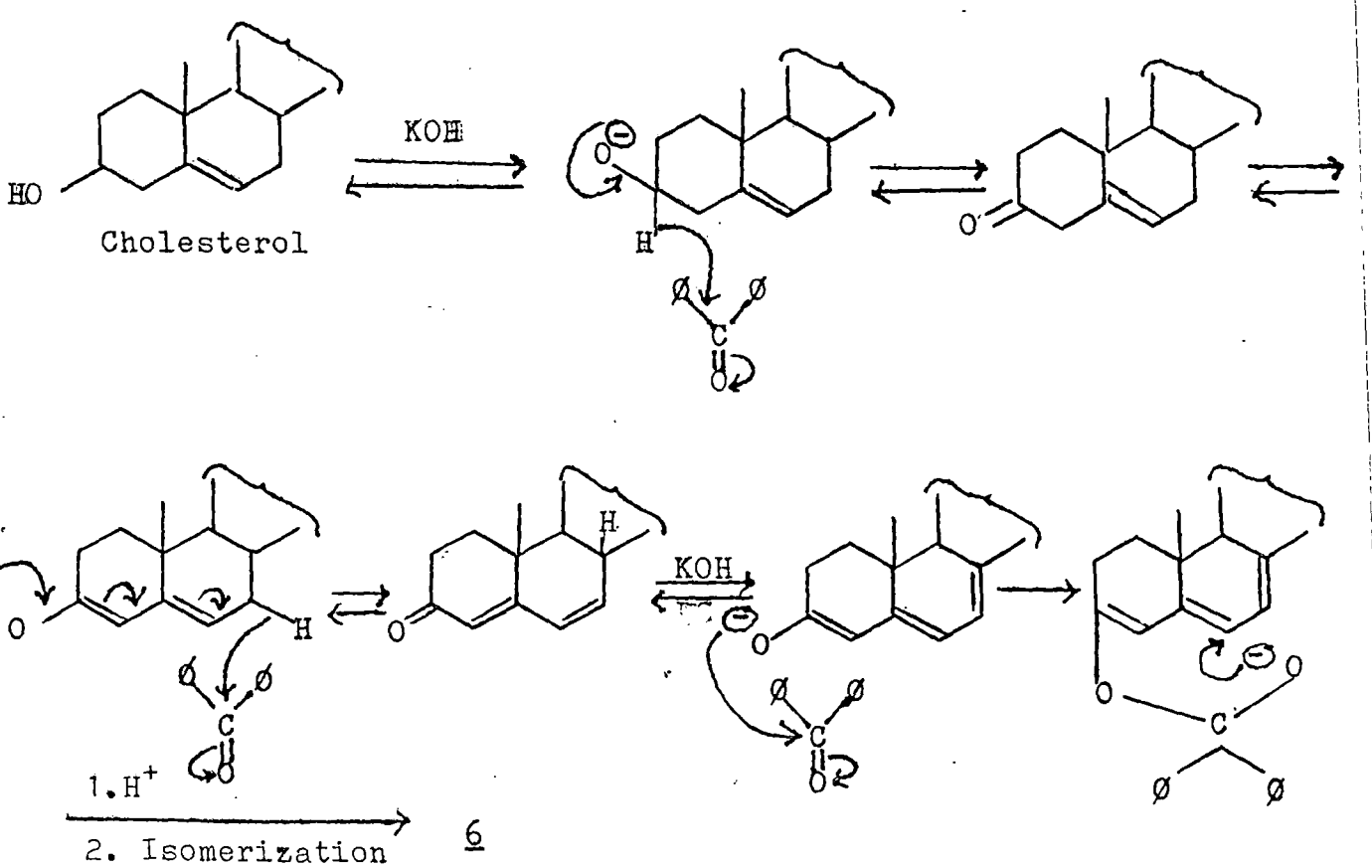
4



6

The formation of 6 has been rationalised as shown in the scheme II:

Scheme - II



The above findings has been reported in Indian J. Chem. and a reprint has been enclosed (Appendix 2).

Chapter - IV consists the reductive action of potassium hydroxide in diethylene glycol on α,β-unsaturated ketone conjugated with an aromatic ring (acetophenone).

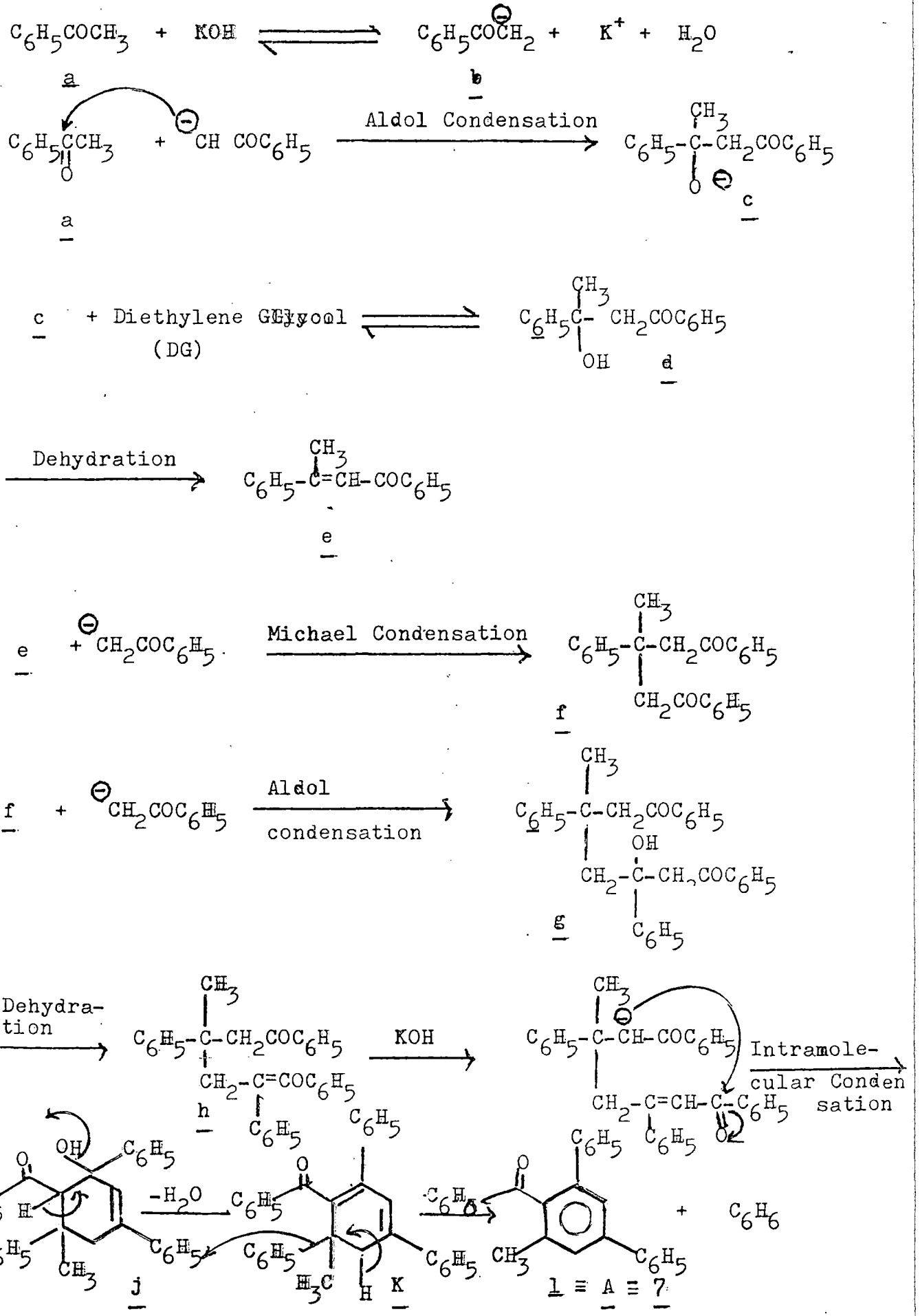
Acetophenone on reduction with potassium hydroxide in diethylene glycol gives 2-methyl-4, 6-diphenyl benzophenone 7 having m.p. 185-86°.

Spectroscopic analysis of 2-methyl-4,6-diphenyl benzophenone 7

The compound 7 exhibited the following spectral data. IR ν_{max}^{nujol} cm^{-1} : 1660 (α,β-unsaturated keto group), 1280, 1270, 940, 880, 775, 760, 750, 720, 700 (aromatic nucleus); UV (ethanol): λ_{max} 245 (ϵ, 30,000); Mass : 348 $[M]^+$; ^1H NMR ($CDCl_3$ with TMS, ppm): 2.22 (methyl group in benzene nucleus), 7-7.7 (protons attached to the aromatic nuclei); ^{13}C NMR ($CDCl_3$ with TMS, ppm): 19.7(q) (methyl carbon on aromatic ring), 126.07 (d), 127.11(d), 127.15(d), 126.62(d), 127.89(d), 127.94(d) (2C), 128.2(d)(2C), 128.8(d)(2C), 129.1(d)(2C), 129.2(d)(2C), 132.9(d)(2C) (for 17 aromatic carbons), 135.7(s), 137.7(s), 137.75(s), 140.3(2C)(s), 140.6(s), 141.8(s) (7 aromatic carbons), 199.5(s) (carbonyl carbon).

The proposed mechanism for the formation of 7 is depicted in Scheme III:

Scheme III

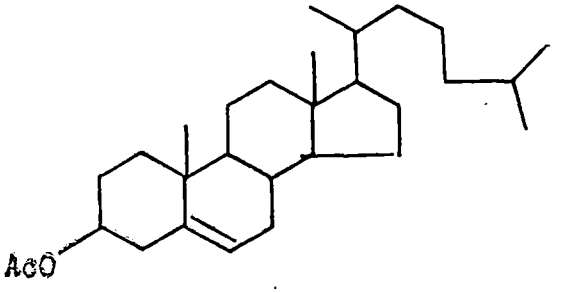

C6H5COCH3 + KOH ⇌ C6H5COCH2⊖ + K+ + H2O
a
b
Aldol Condensation
C6H5CCH3 + CH COC6H5
O
a
C6H5-C(CH3)-CH2COC6H5
O⊖
c
c + Diethylene Glycol (DG) ⇌ C6H5-C(CH3)(OH)-CH2COC6H5
d
Dehydration
C6H5-C(CH3)=CH-COC6H5
e
e + CH2COC6H5⊖
Michael Condensation
C6H5-C(CH3)(CH2COC6H5)-CH2COC6H5
f
f + CH2COC6H5⊖
Aldol condensation
C6H5-C(CH3)(CH2COC6H5)-C(OH)(CH2COC6H5)-C6H5
g
Dehydration
C6H5-C(CH3)(CH2COC6H5)-CH2-C=COC6H5
C6H5
h
KOH
C6H5-C(CH3)-CH-COC6H5
CH2-C=CH-C-C6H5
C6H5
O
Intramolecular Condensation
OH
C6H5
H
C6H5
CH3
C6H5
j
-H2O
C6H5
C6H5
H3C
H
K
C6H5
C6H5
C6H5
CH3
C6H5
l ≡ A ≡ 7
+ C6H6

The mechanism suggested in the above scheme indicates the formation of benzene as one of the products of the overall reactions. This has been found to be true as benzene could be detected by UV spectroscopy of the first fractions of the distillate.

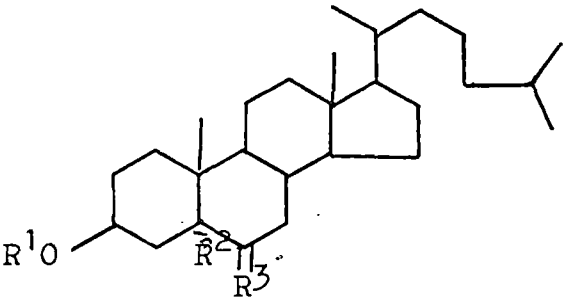
The above findings has been published in Indian J. Chem., 27B, 592 (1988).

B. PART II:

Chapter II describes the action of N-bromosuccinimide on cholesteryl acetate 1 in dimethylsulfoxide. The reaction furnishes six compounds which have been identified as 5α-bromo-6-keto-cholestan-3β-yl acetate 2, 6α-bromo-5β-hydroxycoprostan-3β-yl 3, 5α-hydroxy-6-keto-cholestan-3β-yl acetate 4, 5α, 6β-dihydroxy cholestan-3β-yl 5, 3β, 5α-dihydroxycholestan-6-one 6 and cholestane-3β, 5α, 6β-triol 7 by chemical studies and spectral (IR, mass, PMR and ^{13}C NMR) data. Compound 3 is perhaps reported for the first time.

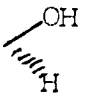


1, Cholesteryl acetate

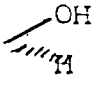


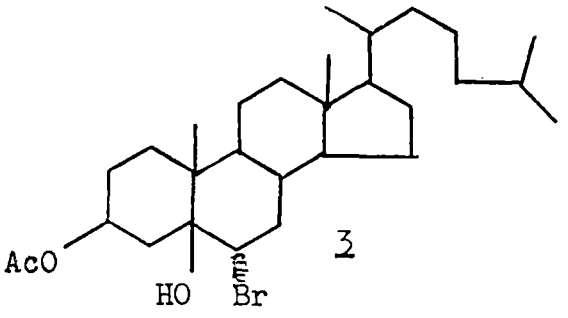
2, R^1= Ac, R^2=Br, R^3 = O

4, R^1=Ac, R^2=OH, R^3 = O

5, R^1=Ac, R^2 =OH, R^3 = 

6, R^1=H, R^2=OH, R^3 = O

7, R^1=H, R^2=OH, R^3 = 



3

The compound 5α-bromo-6-keto-cholestan-3β-yl acetate 2 exhibited the following spectral data.

IR ν_{max}^{nujol} cm^{-1} : 1705 (six membered ring ketone), 1735, 1260 (acetate group); UV (ethanol: λ_{max} 265 nm; M^+H : 521 & 523; ^1H NMR ($CDCl_3$ with TMS, ppm): 0.845 + 0.878(d), 0.849 + 0.882(d), 0.894 + 0.926(d) (three secondary methyls), 0.648(s), 0.985(s) (two tertiary methyls), 2.031(s) (acetoxy methyl), 5.32 (heptet), 3.091, 3.151, 3.166, 3.227(dd), 2.33(t), ^{13}C NMR ($CDCl_3$ with TMS, ppm): See Table - 1, page 60.

The compound 6α-bromo-5β-hydroxycoprostan-3β-yl acetate 3 exhibited the following spectral data.

IR ν_{max}^{nujol} cm^{-1} : 3410 (hydroxyl group), 1740, 1265 (acetoxy group); Mass : m/z 509, 507 (M^+H-H_2O); ^1H NMR ($CDCl_3$ with TMS, ppm):

0.84 + 0.86(d)m 0.85 + 0.87(d), 0.88 + 0.90(d) (three secondary methyls), 0.64(s), 0.99(s) (two tertiary methyls), 2.09(s)(acetoxy methyl), 5.3(s), 4.81(s), 4.53(dd). ^{13}C NMR ($CDCl_3$ with TMS, ppm): See Table 1, page 60.

The compound 5α-hydroxy-6-keto-cholestan-3β-yl acetate 4 exhibited the following spectral data.

IR ν_{max}^{nujol} cm^{-1} : 3380 (hydroxyl group), 1735, 1280-1240 (acetyl group), 1707(six membered ring ketone); Mass : 460 $(M)^+$; ^1H NMR ($CDCl_3$ with TMS, ppm): 0.842 + 0.864(d), 0.845 + 0.867(d), 0.887 + 0.90(d) (three secondary methyls), 0.632(s), 0.799(s) (two tertiary methyls), 1.999(s) (acetoxy methyl), 2.06, 2.08, 2.10, 2.12; 2.709, 2.751, 2.793, 5.02(h)(C-3 methine proton). ^{13}C NMR ($CDCl_3$ with TMS, ppm): See Table-1, page 60.

Spectroscopic analysis of 5α, 6β-dihydroxycholestan-3β-yl acetate (5)

IR ν_{max}^{nujol} cm^{-1} : 3440 and 3390 (two hydroxyl group), 1730-1715(b), 1290-1250(b) (acetoxyl group); Mass: (CI/CH_4) m/z 462 $(M)^+$; ^1H NMR ($CDCl_3$ with TMS, ppm): 0.675(s), 1.19(s), 0.847(d), 0.880(d), 0.92(d) (three pair of doublets for three secondary methyls), 2.025 (acetoxy methyl) 5.157(h)(methine proton geminal to acetoxy group); ^{13}C NMR ($CDCl_3$ with TMS, ppm): See Table-1, page 60.

Spectroscopic analysis of 3β, 5α -dihydroxy cholestan-6-one (6)

IR ν_{max}^{nujol} cm^{-1}: 3260-3500(b) (hydroxyl groups), 1710 (six membered ring ketone); Mass : 416; ^{1}H NMR ($CDCl_3$ with TMS, ppm): 0.637(s), 0.795(s) (two tertiary methyls), 0.845 + 0.867(d), 0.849 + 0.871 (d), 0.890 + 0.992(d) (three secondary methyls), 2.076, 2.092, 2.12, 2.136, 2.68, 2.72, 2.76, 3.973(h) (methine proton geminal to the equatorial hydroxyl group); ^{13}C NMR ($CDCl_3$ with TMS, ppm): See Table-1, page-60.

Spectroscopic analysis of cholestane-3β, 5α, 6β-triol (7)

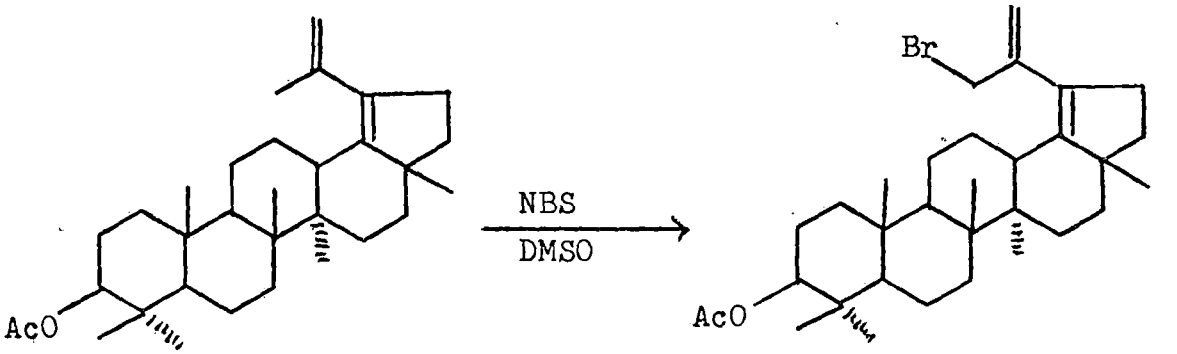
IR ν_{max}^{nujol} cm^{-1} : 3422 to 3340 (hydroxyl groups); Mas (CI/CH_4): 419 $(MH)^+$; ^{1}H NMR ($CDCl_3$ with TMS, ppm): 0.674(s), 1.1179(s) (two tertiary methyls), 0.845 + 0.867(d), 0.850 + 0.872(d), 0.888 + 0.99(d) (three secondary methyls), 3.538(t) (proton geminal to hydroxyl group), 4.096(h) (axial proton geminal to the C-3 hydroxyl group); ^{13}C NMR ($CDCl_3$ with TMS, ppm): See Table-1, page-60.

The above findings has been published in Indian J. Chem. 27B, 846(1988).

Chapter - III deals with the reaction of N-bromosuccinimide triterpenoids of lupane skeleton in dimethyl sulfoxide.

Section A:

3β-acetyl lup-18(19), 20(29)-diene 31 on reaction with NBS in DMSO yielded 3β-acetoxy-30-bromo-lup 18(19), 20(29) diene (41).



31 41

The structure of 41 was established by spectral analysis.

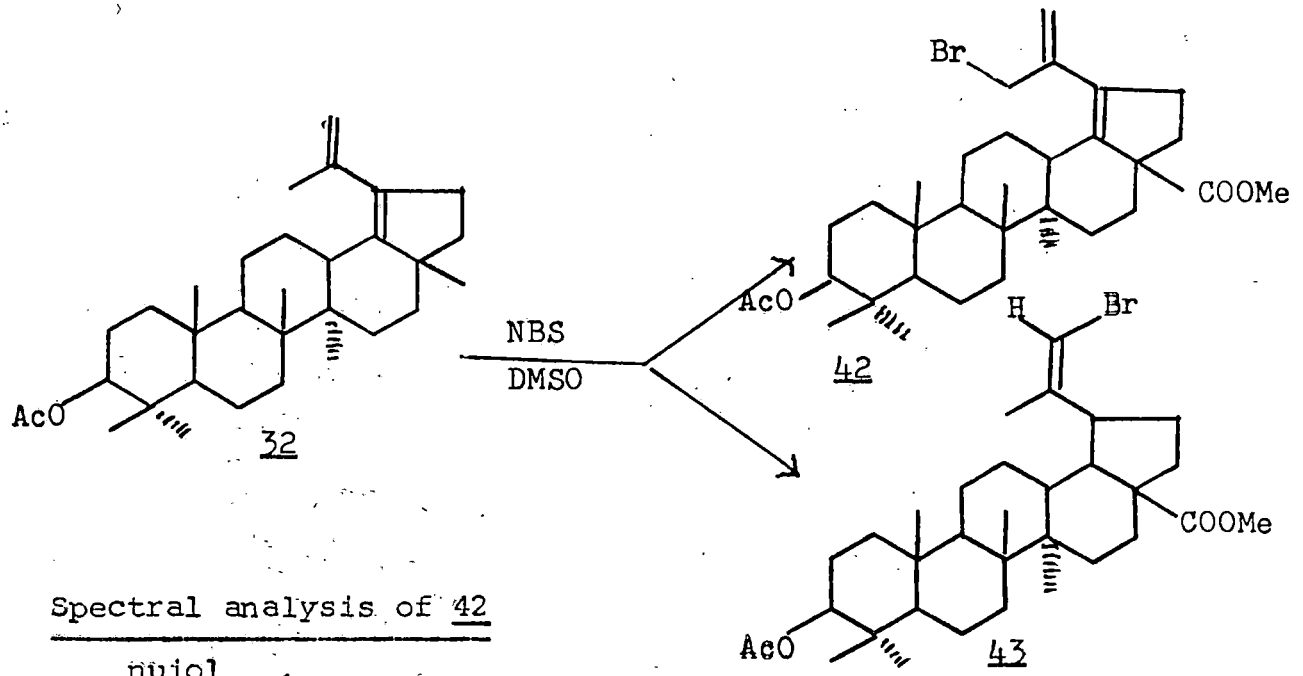
Spectral analysis of 41 :

IR ν_{max}^{nujol} cm^{-1} : 1740, 1250, 910, 700; Mass : 546; ^1H NMR ($CDCl_3$ with TMS, ppm): 0.84, 0.85, 0.89, 0.90, 1.05, 1.08, 2.04, 4.04, 4.48, 4.85 and 5.225.

Section B:

It consists the reaction of 3β-acetoxy-lup-18(19)-20(29)-diene-28 methyl carboxylate 32 with NBS in DMSO.

The compound 32 gives two products 3β-acetoxy-30-bromo-lup-18(19), 20(29)-diene-28-methyl carboxylate 42 m.p. 246° and (E) 3β-acetoxy-29-bromo-lup-18(19), 20(29)-diene-28 methyl carboxylate 43, m.p. 278°.



Spectral analysis of 42

$IR\nu_{max}^{nujol}$ cm^{-1} : 1750, 1240, 1190, 990, 700

Mass : 590(5.2), 588(5.4), 530, 528, 509, 449, 258, 203, 189, 185 (base).

^{1}H NMR ($CDCl_3$ with TMS) : 0.83, 0.84, 0.87, 0.93, 0.965, 2.045, 3.67, 4.065, 4.475, 5.065 & 5.295 ppm.

^{13}C NMR ($CDCl_3$ with TMS) : See table - 3 in the text p. 77.

Spectral analysis of 43

$IR\nu_{max}^{nujol}$ cm^{-1} : 1750, 1240, 1190, 990, 700 cm^{-1}.

Mass : 590 and 588, 530, 528, 509, 449, 389, 257, 197, 189, 185 (base).

: +ve

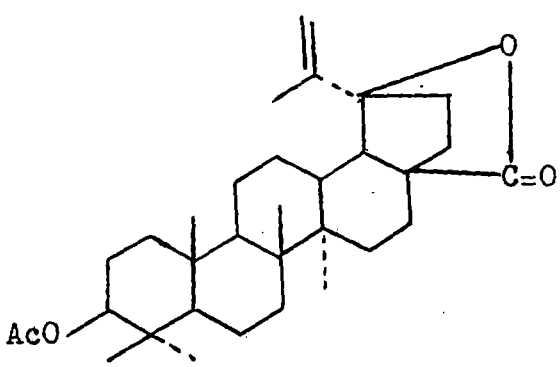
: +ve

^{1}H NMR ($CDCl_3$ with TMS) : 0.830, 0.84, 0.87, 0.89, 0.965, 1.89, 1.885, 2.04, 3.09, 3.095, 4.475, 5.9025, 5.905 ppm.

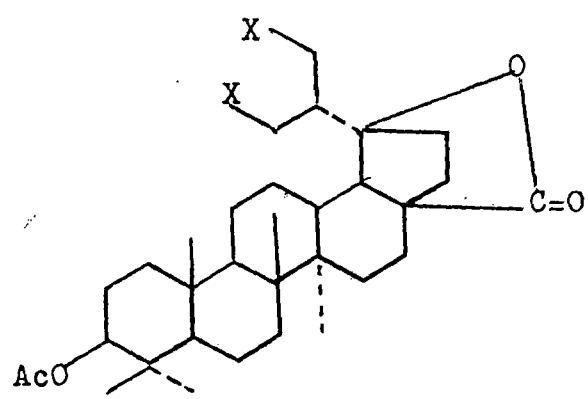
^{13}C NMR ($CDCl_3$ with TMS) : See table - 3 in the text.

Section - C:

It consists the reaction of 3β-acetoxy-lup-20(29)ene, 28⟶19 olide 33 with NBS in DMSO. In this reaction compound 3β-acetoxy, 29,30-dibromo-lup-28⟶19 olide 44 is formed having m.p. 226°C.



33



44, X = Br

44a, X = H

The structure of compound 44 has been established by spectroscopic analysis.

The compound 44 exhibits the following spectral data:

IR ν_{max}^{nujol} cm^{-1} : 1780, 1740, 1260

Mass : 658, 656 and 654 (1:2:1), 598, 596, 594, 583, 581, 579, 516, 514, 504, 499, 496, 468, 436, 421, 408, 393, 365, 274, 203, 189 (base) and 187

^{1}H NMR ($CDCl_3$ with TMS, ppm) : 0.830, 0.865, 0.940, 0.95, 2.04, 3.855, 3.98, 4.45 ppm.

The structure of 44 was confirmed by converting it to a known derivative: 3β-acetoxy-lupan-28⟶19β-olide (44a) on treatment with Zn/CH_3COOH.

C. Part III

Chapter I describes the systematic investigation on the bark of Gyanocordia odorata and isolation of two new triterpenes 3β-o-acetyl odollactone $C_{32}H_{48}O_3$, m.p. 302-3° and 3β-odollactone $C_{30}H_{48}O_3$, m.p. 310°.

Section - A consists the isolation of a new triterpenoid acetate, 3β-O-acetyl odollactone 1. The compound 1 was obtained from the elution of Petrol : benzene (4:1) on silica gel column. The compound 1 exhibits the following spectral data:

IR ν_{max}^{nujol} cm^{-1}: 1747 (γ lactone), 1725, 1240 (acetate), 987, 885,

Mass: 498, 438, 423 $(438-CH_3)^+$, 383, 371, 370, 316, 315, 271, 269, 255, 191, 189, 177, 175, 149, 149, 135 & 123 (base).

Section-B describes the hydrolysis of compound 1 by KOH/MeOH to 2 having m.p. 310°C, $[\alpha]_D = -2.48°$.

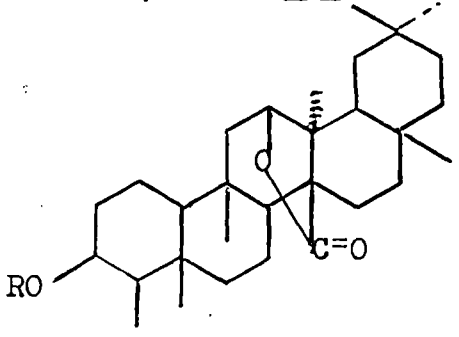
The compound 2 exhibits the following spectral data:

IR ν_{max}^{nujol} cm^{-1} : 3520 (hydroxy gr.), 1740 (lactone); 960.

Mass : 456 $(M)^+$; ^{1}H NMR ($CDCl_3$ with TMS, ppm): 0.73(s), 0.88(s), 0.96(s), 0.98(s), 1.02(2), 1.16(s) (six tertiary methyls), 0.87(d) (secondary methyls), 3.72 (axial proton geminal to a hydroxy group), 4.33 (proton attached to lactyl oxygen).

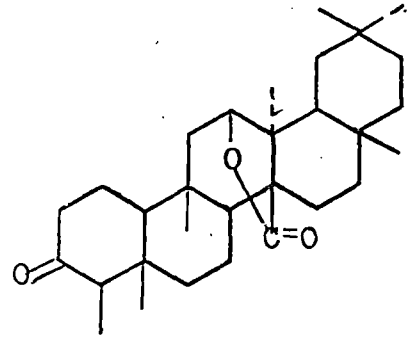
Acetylation of the compound 2 gave back the original compound 1. Chronic acid oxidation of the alcohol 2 yielded a compound 3 of m.p. 314°C. The compound 3 has been found to be identical with authentic odolactone[1].

Section -C describes the structure of compound 1 and hence 2. Above findings it is concluded that the stereochemistry of the hydroxyl group has been established as it has been reported by Pradhan et al[1] that odollactone contains the hydroxy group at C-3 position as equatorially oriented which on oxidation formed odolactone. The present alcohol 2 can be regarded as isomeric alcohol of odollactone and hence the acetate 1 is also isomeric to the O-acetyl odollactone. Thus the present acetate is designated as 3β-O-acetyl odollactone 1. However, in view of the revised structure of odolactone as 18a, the present compound, 3β-O-acetyl odollactone should also be designated as 3β-O-acetyl friedel-27-→15α-olide 18e and the corresponding alcohol as 18d.

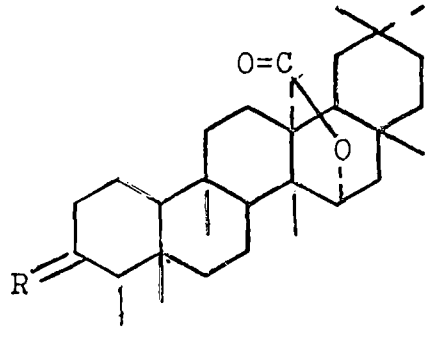


1, R = Ac

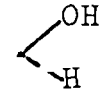
2, = H

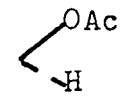


3



18a, R = O

18d, R = 

18e, R = 

Further elution of the column the following compounds were obtained. O-acetyl-odollactone, odolactone, β-sitosterol, 3α-odollactone, ~~odollactone~~ and trichadenic acid.

Chapter II deals with the reinvestigation on the structure establishment of odolactone and its derivatives by some chemical reactions e.g. Wolff-Kishner reduction, Lithium aluminium hydride reduction and lithium ethylene diamine reduction.