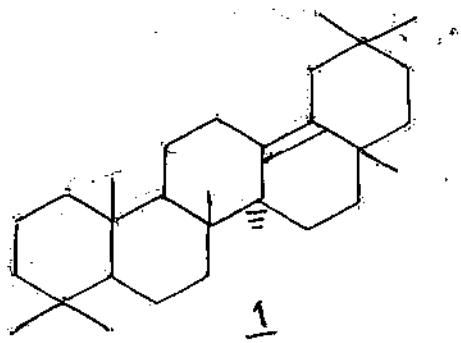
Chapter II

A short review on Δ^{14}-Taraxerene triterpenoids

1. Taraxerol and taraxerone

An alcohol named taraxerol first isolated from Taraxacum officinale[2] and Litsea dealbata[3] was shown to be identical with alnulin[4-7] obtained from the bark of grey alder, by Jeger[8] et al. in 1950. An alcohol, skimmiol, isolated from Skimmia japonica by Takeda[9-11] in 1945, was also shown to be identical with taraxerol by Brooks[12]. The triterpenoid nature of taraxerol was proved by Burrows[2,12] and also by Takeda and his coworkers[13,14]. On selenium dehydrogenation 1:2:3:4-tetramethylbenzene, 2:7-dimethyl-, 1:2:7-trimethyl- and 1:2:5:6-tetramethyl-napthalene along with 1:8 dimethyl-picene, were isolated. These facts suggested a general relationship to amyrins with normal triterpenoid rings A and B. The presence of unsaturation in taraxerol was shown by conversion of its acetate to an epoxide $C_{32}H_{52}O_3$, m.p. 257-60°, $(\alpha)_D$ + 47.3° with perbenzoic acid. The unsaturation was probably present as the group C=CH (I.R. band at 814 cm^{-1}). Conversion of taraxerol to dihydrotaraxerol, $C_{30}H_{52}O$, m.p. 261-2°, $(\alpha)_D$ + 47.3° was claimed by Takeda. Taraxerol by CrO_3-Py oxidation gave taraxerone $C_{30}H_{48}O$, m.p. 238-40°, $(\alpha)_D$ + 8°. The latter on further oxidation furnished dicarboxylic acid which on ring closure gave a cyclopentanone derivative. These sequence of reactions showed the secondary nature of hydroxyl group present in a six membered ring.

That taraxerol belongs to β-amyrin group was proved by Takeda[10] and subsequently by Jeger[8]. Clemmensen reduction of taraxerone gave a hydrocarbon m.p. 190-91°, $(\alpha)_D$ - 34°, identical with δ'-amyrene 1 which was also obtained by pyrolysis of taraxeryl benzoate followed by hydrogenation. This and other work led Takeda to formulate taraxerol as 2 (olean-18-en-3β-ol). This was invalidated[15] when this structure was assigned to germanicol 2.



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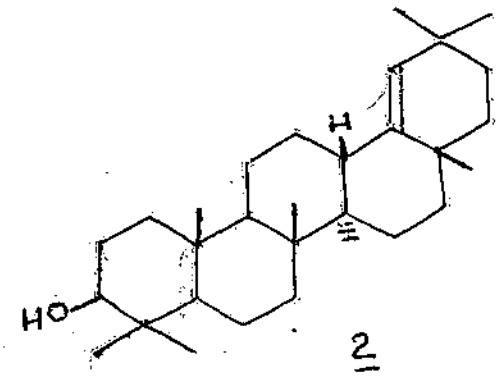
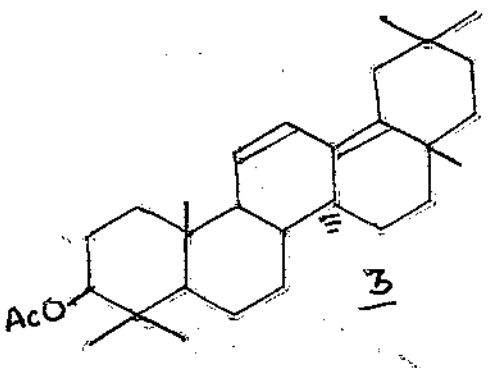


2

Oxidation of taraxeryl acetate with SeO_2 gave two isolable products, olean-11:13(18)-dienyl acetate 3, m.p. 226°, $(\alpha)_D$ - 58°, λmax 242 mμ, log ε 4.35, 250 mμ, log ε 4.4; 259 mμ, log ε 4.2 and the diene-dione 4, m.p. 237-40°, $(\alpha)_D$ - 90°, λmax 276 mμ log ε 4.1. These results established decisively the presence of the hydroxyl group at C-3. Now with the clearly made proviso that no skeletal change had taken place during SeO_2 oxidation the structure 5 was advanced for taraxerol.



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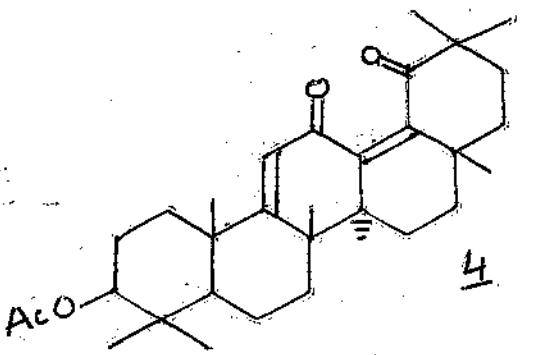

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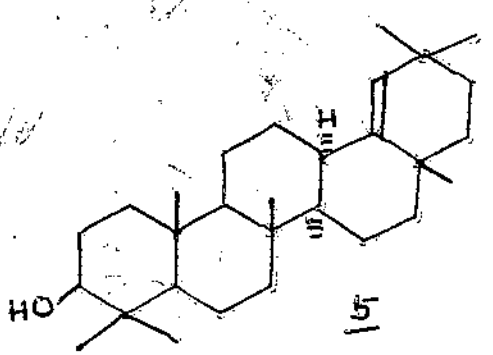
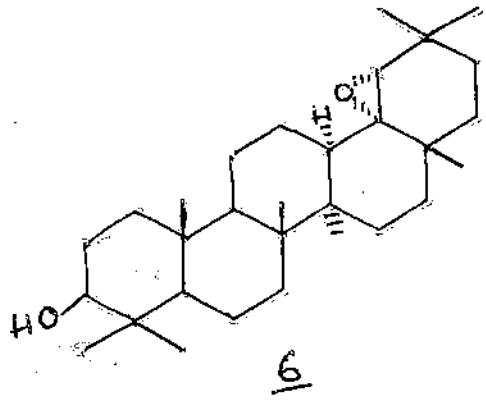


5

If 5 was indeed the correct structure then the oxide derived would be 6 and the unsaturated alcohol (as was claimed by Takeda) would be 7. But 7 being an allylic alcohol would be unlikely to survive in the conditions of its genesis. This structure also could not explain the formation of oleana-2:12 diene on dry distillation of taraxeryl benzoate, as reported by Takeda, as it would require the migration of the double bond at 18:19 past the thermodynamically more stable 13(18) position to the less stable 12:13 position leaving also, the less stable configuration at C_{18}.



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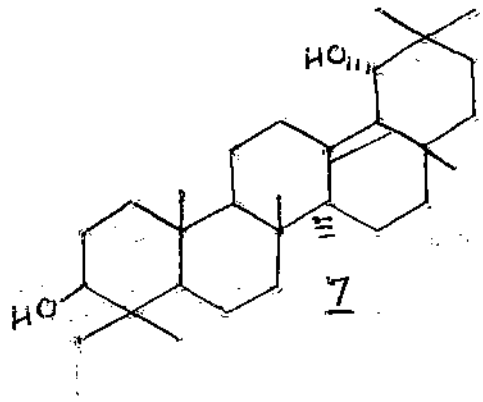
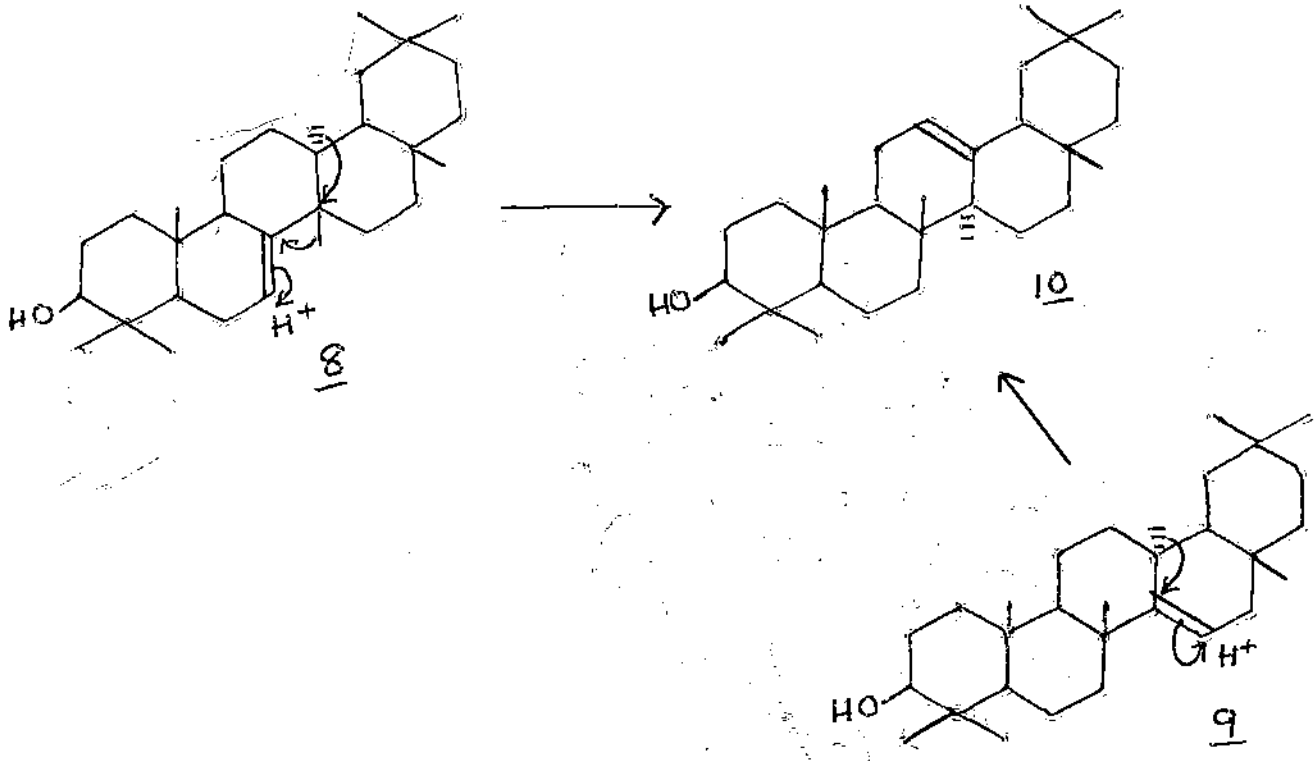
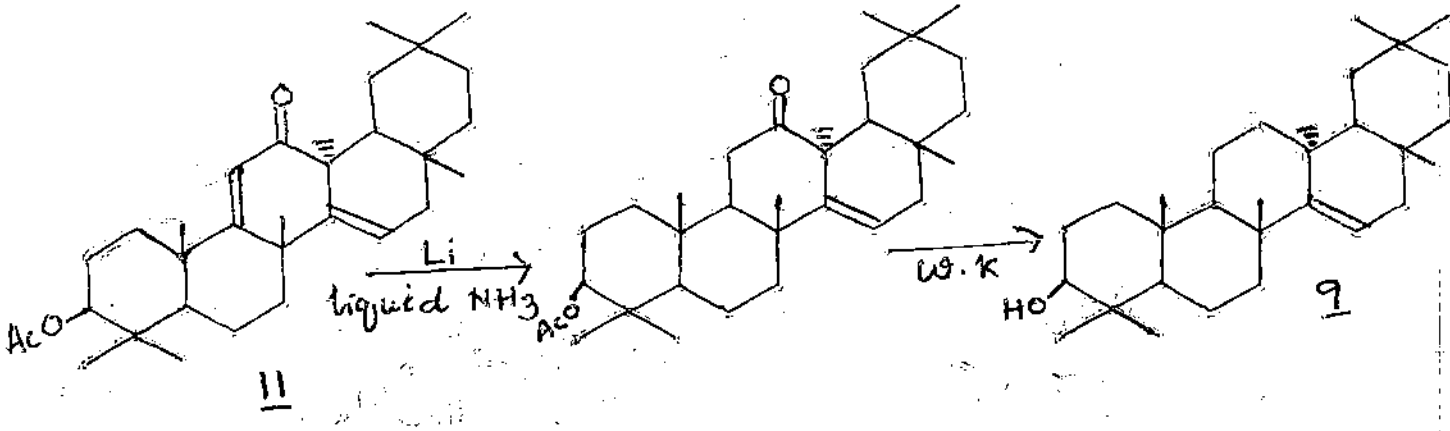


7

When a suspension of taraxeryl acetate in acetic acid at 90° was treated with hydrochloric acid in a very short time an excellent yield of β-amyrin acetate was obtained. This indicated that in the formation of oleanane derivatives from taraxerol a rearrangement had taken place. Since rearrangement has led to the β-amyrin structure taraxerol cannot already possess it. Two structures, at least, could be presented 8 and 9. The conversion of 8 to β amyrin is strongly reminiscent of euphol → isoeuphol rearrangement[16] which involved protonation of the double bond with concerted methyl migration from C_{14} to C_{13} as represented below. A similar rearrangement for 9 is also possible. The formulation 9 was preferred because of certain analogies with previous work on β-amyrin series[17].



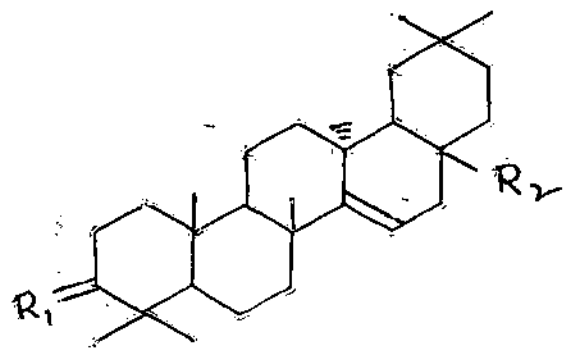
The partial synthesis from 12 keto-iso-oleana $\Delta^{9(11):14(15)}$ dienylacetate[19] 11 by Spring[18] and co-workers as shown below established beyond doubt that taraxerol possesses the structure 9.



2. Myricadiol 12

From the bark of Myrica gale Ryabimin and Matyukhina[20] isolated a triterpene diol, myricadiol, m.p. 273-4°, which has been assigned structure 12 on the basis of the following arguments. It gave a diacetate, $C_{34}H_{54}O_4$ m.p. 256-58°, $(\alpha)_D$ + 1°. Oxidation of myricadiol with chromium trioxide-pyridine gave myricanal 13a an oxo-aldehyde, $C_{30}H_{48}O_2$, m.p. 256-7° (disemicarbazone m.p. 298° bis 2:4 dinitrophenyl hydrazone m.p. 247°). Treatment of the latter with diethylene glycol, N_2H_4 and KOH gave taraxerene m.p. 201-2°, which was also prepared from taraxerone by similar Wolff-Kishner reduction. The latter on being treated with HCl-chloroform gave olean-12-ene m.p. 161-5°-162.5°. Acid isomerisation of myricadiol diacetate with acetic acid-HCl mixture gave erythrodiol diacetate, $C_{34}H_{54}O_4$, m.p. 184.5-85.5°, $(\alpha)_D$ + 60° which on hydrolysis gave erythrodiol[21] m.p. 231.5°-32.5°, $(\alpha)_D$ + 83°. Myricadiol evidently contained a primary and a secondary hydroxyl group as indicated by the spectrum of the oxidation product described above and evidently was taraxen-14-ene-3β, 28 diol.

Myricadiol was also isolated by Dhar and Agarwal[22] from Myrica esculenta. Recently Bose and Paul[23] isolated myricadiol and have recorded mass spectra of the compound.



12 , $R_1 = H(OH\beta)$, $R_2 = CH_2OH$

13 , $R_1 = H(OH\beta)$, $R_2 = CHO$

13a , $R_1 = O$, $R_2 = CHO$

14 , $R_1 = H(OCH_3\beta)$, $R_2 = CH_3$

15 , $R_1 = H(OH\alpha)$, $R_2 = CH_3$

3. Myriconal 13

The Russian workers[24,25] also isolated another new triterpene $C_{30}H_{48}O_2$ m.p. 288°, from the bark of Myrica gale. The structure 13 was assigned to it. Myriconal gave an acetate $C_{32}H_{50}O_3$ m.p. 304-5° and a 2:4 dinitrophenyl hydrazone m.p. 250°. On lithium aluminium hydride reduction it furnished myricadiol 12, showing thereby that it must be represented either as Δ14-taraxerene-28-ol-3 one or Δ-14-taraxerene-3 ol-28-al 13. The decision in favour of structure 13 was made on the basis of the I.R. spectrum which showed clearly an aldehyde peak.

4. Sawamilletin 14

Sawamilletin (taraxeryl methyl ether) 14 has been isolated by H. Ito et al.[26a] and J.A. Bryce et al.[26b] Both from chemical studies and spectral properties its structure has been assigned as 14. It has been synthesised by the reaction of taraxerol with methyl iodide.

5. Epi-taraxerol 15

Epi-taraxerol 15 $C_{30}H_{50}O$ m.p. 261-2°, $(\alpha)_D$ - 22.6° has recently been isolated by the present author[27] from the neutral fraction of the stem-bark of Macaranga Denticulata. The details regarding its chemistry is reported in the next chapter (Chapter III).