

CLAISEN REARRANGEMENT TO A META SIDE CHAIN IN
THE QUINOLINE RING SYSTEM

Yasuo Makisumi

Shionogi Research Laboratory, Shionogi & Co., Ltd.,
Fukushima-ku, Osaka, Japan

(Received 12 February 1964)

RECENTLY, the author (1) reported the thermal rearrangement reaction of 5,6-dimethyl-7-allyloxy-s-triazolo[1,5-a]pyrimidine with migration of the allyl group to the meta-active methyl group. The mechanism of this rearrangement is similar to that of the para-Claisen rearrangement (2), and the reaction may be considered to be a new type Claisen rearrangement. As an extensive example of the reaction, we wish to report a successful "out-of-ring" migration of an allyl group to the α -carbon of a meta-alkyl side chain in the quinoline ring system.

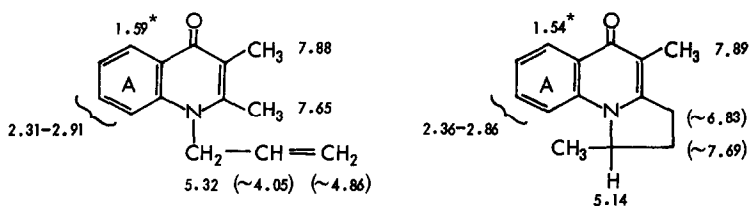
Heating 2,3-dimethyl-4-quinolyl allyl ether (Ia) (3) at 200° for 30 min. without solvent resulted in the formation of three isomeric compounds. Treatment of the reaction mixture with benzene afforded a 92% yield of 2-(3-butenyl)-3-methyl-4-quinolinol (IIa) (4), m.p. 261-262°; $\nu_{\text{max}}^{\text{Nujol}}$ 3272 (NH), 1640 (lactam C=O), and 997 and 912 (CH=CH₂) cm⁻¹, as benzene-insoluble crystals. The benzene-soluble part was subjected to alumina chromatography to give a 2.0% yield of 1-allyl-2,3-dimethyl-4-quinolone (IIIa), m.p. 133-134°; $\nu_{\text{max}}^{\text{CHCl}_3}$ 1620 (C=O) (5) and 987 and 925 (CH=CH₂) cm⁻¹, and a 2.1% yield of 1,4-dimethyl-2,3-dihydropyrrolo-[1,2-a]quinolin-5(1H)-one (IVa), m.p. 191-192°; $\nu_{\text{max}}^{\text{CHCl}_3}$ 1625 cm⁻¹ (C=O) (5). The ultraviolet spectra of these products showed similar absorption curves which

were characteristic for the 4-quinolone nucleus as shown in Table I. The structure of these rearranged products was established by the following data. Catalytic reduction (Pt-c in ethanol) of the 4-chloro derivative (Va), m.p. 58-58.5°, which was obtained from IIa by chlorination with phosphoryl chloride, afforded alkylquinoline (VIa), b.p._{0.15} 105-106°; picrate, 181-182°. This compound was identified by infrared spectra comparison with 2-butyl-3-methylquinoline synthesized from 2,3-dimethylquinoline by an unequivocal method (6); propylation with propyl bromide in liquid ammonia in the presence of sodium amide. The n.m.r. spectra of IIIa and IVa substantiated their assigned structures as illustrated in Fig. 1. Furthermore, IVa was identical by direct comparison (infrared spectrum and mixed melting point determinations) with the sample which was obtained by intramolecular cyclization of IIa on heating in the presence of zinc chloride.

Analogous rearrangement of 2-(3-butenyl)-3-methyl-4-quinolyl allyl ether (IIb), b.p._{0.12} 138-139°; picrate, m.p. 115-116°, prepared by allylation of IIa, under the same condition as above gave three rearranged products: 2-(1-allyl-3-butenyl)-3-methyl-4-quinolinol (IIb) (4), m.p. 239-240°; $\nu_{\max}^{\text{Nujol}}$ 3269 (NH), 1633 (lactam C=O), and 994 and 920 (CH=CH₂) cm⁻¹, in 90% yield, 1-allyl-2-(3-butenyl)-3-methyl-4-quinolone (IIIb), m.p. 83.5-84.5°; $\nu_{\max}^{\text{CHCl}_3}$ 1620 (C=O) (5) and 994 and 921 (CH=CH₂) cm⁻¹, in 2.0% yield, and 1,4-dimethyl-3-allyl-2,3-dihydropyrrolo[1,2-a]quinolin-5(1H)-one (IVb), m.p. 200-201°; $\nu_{\max}^{\text{CHCl}_3}$ 1622 (C=O) (5) and 993 and 919 (CH=CH₂) cm⁻¹, in 0.6% yield. As shown in Table I, the ultraviolet spectra of these products were similar to those of the rearranged products of Ia. IIb was converted by catalytic reduction into alkylquinoline (VIb), b.p._{0.14} 126°; picrate, m.p. 150-151°, via the 4-chloro derivative (Vb), b.p._{0.14} 127-128°; picrate, m.p. 144-145°. VIb was proved to be identical with

Table I. Ultraviolet Absorption Spectra

Compd. No.	EtOH					
	λ_{\max}	$m\mu$	$\log \epsilon$	λ_{\max}	$m\mu$	$\log \epsilon$
IIa	240 (4.51)	246.5 (4.50)	323 (4.09)	336 (4.11)		
IIb	241 (4.53)	246.5 (4.53)	324 (4.10)	337.5 (4.14)		
IIIa	242.5 (4.44)	249 (4.42)	329 (4.12)	342 (4.16)		
IIIb	244 (4.47)	250 (4.45)	331 (4.13)	345.5 (4.20)		
IVa	242.5 (4.43)	248.5 (4.44)	328.5 (4.10)	341 (4.11)		
IVb	243 (4.46)	250 (4.47)	329 (4.10)	341.5 (4.13)		

Fig. 1. N.m.r. Spectral Data^{a, b} (chemical shift : τ)

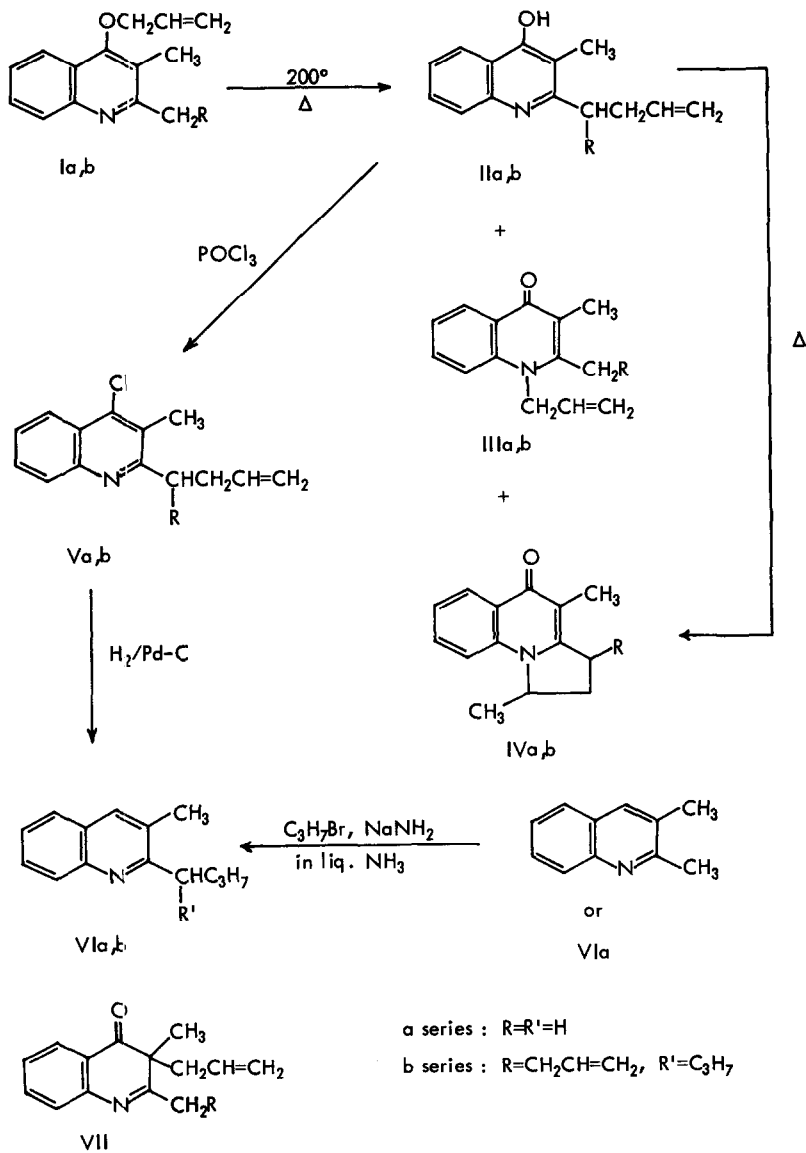
a, The spectra were observed on 10% (w/v) solutions of the samples in deuteriochloroform containing tetramethylsilane as an internal standard, by using a Varian A-60 Spectrometer.

b, Approximate values in parentheses measured to centre of the corresponding signals (multiplets).

* Ref. 7.

2-(1-propylbutyl)-3-methylquinoline prepared by propylation of VIa under the same condition as above. The n.m.r. spectra of IIIb and IVb also substantiated the above assigned structures. IVb was also identical with the intramolecular ring closure product of IIb.

Thus, it was evident that in thermal rearrangement of 3-substituted 2-alkyl-4-quinolyl allyl ethers, migration of the allyl group to the α -carbon of the meta-alkyl side chain readily occurs. In addition, it was also evident that the similar



rearrangement to the para-ring nitrogen corresponding to para-Claisen rearrangement is observed.

In order to determine whether both types of rearrangements proceed competitively or consecutively, the C-allyl compounds IIa,b and the N-allyl compounds IIIa,b were respectively subjected to rearrangement conditions. Careful investigation of the reaction mixture failed to reveal the presence of any of the transformed compounds, except the cyclization compounds IVa,b from the C-allyl compounds (namely, no IIa \rightleftharpoons IIIa and no IIb \rightleftharpoons IIIb).

These results rule out the possible existence of a consecutive pathway between both types of rearrangement products and demonstrate the formation of IIa,b and IIIa,b from Ia,b as a result of competitive rearrangements of the allyl group from the oxygen to the α -carbon of the meta-side chain and to the para-ring nitrogen.

From current views (2) on para-Claisen rearrangement, it should be considered that both types of rearrangement proceed by a mechanism involving a double inversion of a migrating allyl group via the same dienone-type intermediate (VII) and compete in the second six-membered cyclic stages having a different orientation of a migrating allyl group.

Research is in progress to elucidate the mechanism of this new type Claisen rearrangement and the results will be reported shortly.

For all the compounds described satisfactory elemental analysis were obtained.

Acknowledgements. The author is grateful to Prof. Emeritus E. Ochiai of the University of Tokyo, to Dr. K. Takeda, Director of this Laboratory, and to Dr. H. Kano of this Laboratory, for their interest on this work.

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