AROMATIC VERSIONS OF CLAISEN REARRANGEMENT OF LACTONIC SILYL ENOLATES — A NOVEL APPROACH TO FURANOSESQUITERPENE FRAMEWORK

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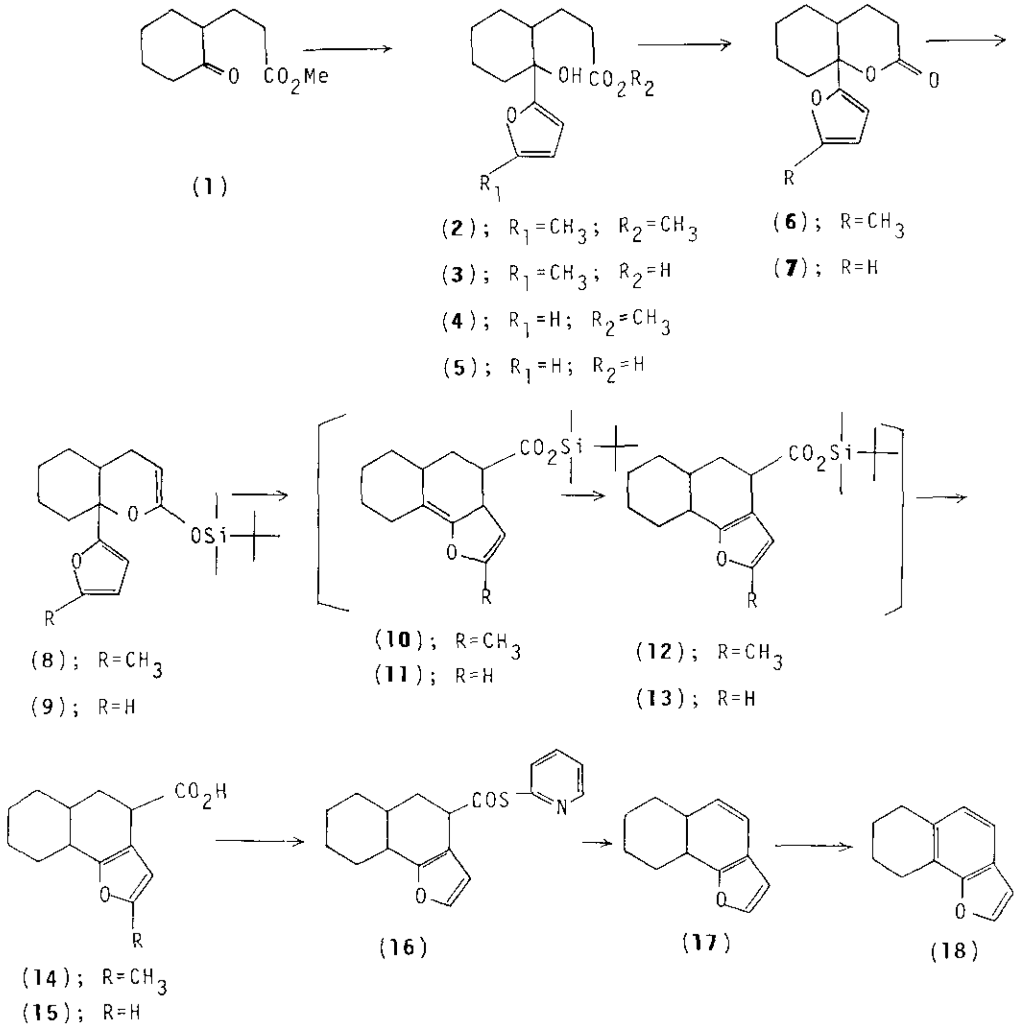
Abstract — *A new route to the decalin systems* (**14**) *and* (**15**) *is described. The key step for this synthesis is the Claisen rearrangement of furfuryl lactonic silyl enolates* (**8**) *and* (**9**) *derived from the furfuryl lactones* (**6**) *and* (**7**), *respectively.*

In the preceeding paper[1], we described the aromatic version of an Ireland's allylic ester silyl enolate rearrangement and could show that the rearrangement occurred under remarkably mild conditions. The most attractive feature of the Ireland's rearrangement seems that a relatively accessible acyl oxygen bond is used to generate a more difficultly available carbon-carbon bond. Especially in the case of lactone, cycloalkenes are readily available[2,3]. If this could be the case for our aromatic version of the Ireland's rearrangement, functionalized furanocycloalkenes could be generated. On the other hand, the decalin systems fused with a furan ring are an important basic skeleton of eudesmane or eremophilane types of sesquiterpenes[4] and numerous investigations directed toward a synthesis of this type of compounds have been cumulated up to this time[5,6]. In these concepts, we have undertaken the investigation to explore a new synthetic entry to furanodecalin systems.

Firstly, the furfuryl lactones (**6**) and (**7**), key intermediates for generating furfuryl lactonic silyl enolates (**8**) and (**9**), were prepared as follows. The ketonic ester (1) [m/z 184 (M^+)], prepared in 60 % yield by successive treatment (pyrrolidine, benzene, reflux, 12 h; methyl acrylate, dioxane, reflux, 1.5 h) of cyclohexanone, reacted with 2-lithio-5-methylfuran[7] (THF, -78 °C, 2 h) to give the furfuryl ester (**2**) and then the furfuryl carboxylic acid (**3**), obtained by the hydrolysis (LiOH, THF-H_2O, room temperature, 12 h) of **2**, was lactonized (silica gel, CH_2Cl_2, room temperature, 12 h) to furnish the furfuryl lactone (**6**) as a stereoisomeric mixture [m/e 234 (M^+); ν max ($CHCl_3$) 1730 cm^{-1}] in 35 % overall yield based on 1. The furfuryl lactone (**7**) [m/e 220 (M^+); ν max ($CHCl_3$) 1720 cm^{-1}] was also prepared in 58 % overall yield starting from the ketonic ester (**1**) by using 2-lithiofuran[8], instead of 2-lithio-5-methylfuran under the same conditions described for the synthesis of the furfuryl lactone (**6**), via the furfuryl ester (**4**) and the furfuryl carboxylic acid (**5**). Silylation (TBSCl, LDA, HMPA-THF, -78 C, 1 H) of **6** and **7** gave the furfuryl lactonic silyl enolates (**8**) and (**9**), respectively, which were subjected to the rearrangement (toluene, reflux, 12 h) and then the hydrolysis (10 % HCl, THF, room temperature, 5 min) of the resulting silyl esters (**12**) and (**13**) to afford the carboxylic acids (**14**) [m/z 234 (M^+); max ($CHCl_3$) 1710 cm^{-1}; (CCl_4) 2.16, 2.20 (3H, each s, Me) and 5.77, 5.83 (1H, each br s, ArH)] and (**15**) [m/z 220 (M^+; ν max ($CHCl_3$ 1720 cm^{-1}; δ (CCl_4) 6.26 (1 H, m, ArH) and 7.06 (1 H, m, ArH)] in 28 % and 55 % overall yields, respectively as stereoisomeric mixtures. In these reactions, it is obvious that [3.3] sigmatropic rearrangement and hydrogen shift were occurred successively giving firstly **10** and **11** and then aromatized compounds (**12**) and (**13**) respectively. Finally, the decarboxylation of **15** was conducted under Mukaiyama's conditions[9] [2-dipyridyl disulfide), Ph_3P, CH_3CN, room temperature, 0.5 h; Zn, cat. $NiCl_2$, DMF, 100°C, 1 h] to afford the tetrahydronaphthofuran (**18**) [m/z 172(M^+); δ (CCl_4) 6.55 (1H, d, J=2 Hz, ArH), 6.76(1H, d, J=8 Hz ArH), 7.16(1H, d, J=8 Hz ArH), and 7.42(H, d, J=2 Hz, ArH). UV_{max} λ 246, 276 and 285 nm][10] in 54% yield, which was derived by the oxidation of the initially expected compound (**17**) <u>via</u> the thioester (**16**).



(1)

(**2**); $R_1=CH_3$; $R_2=CH_3$

(**3**); $R_1=CH_3$; $R_2=H$

(**4**); $R_1=H$; $R_2=CH_3$

(**5**); $R_1=H$; $R_2=H$

(**6**); $R=CH_3$

(**7**); $R=H$

(8); $R=CH_3$

(9); $R=H$

(**10**); $R=CH_3$

(**11**); $R=H$

(**12**); $R=CH_3$

(**13**); $R=H$

(**14**); $R=CH_3$

(**15**); $R=H$

(16)

(**17**)

(18)

Thus, we could disclose a new route for the synthesis of furanosesquiterpene framework, although the stereochemistry of the synthetic intermediates remained unknown.

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