# Diels-Alder Reaction of Hedychenone and Maleic Anhydride

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**Abstract:** Diels-Alder reaction of hedychenone **1** and maleic anhydride **2** gave several products **4**~**7**, whose structures were identified by spectral methods. Effect of temperature on the reaction was disscussed.

**Keywords:** Diels-Alder reaction, hedychenone, antitumor activity, *hedychium* genus.

Several diterpenoids with antitumor activity, including hedychenone **1**, a furanoid compound, were previously isolated from *Hedychium* genus[1]. In attempt to obtain some diterpenoid derivatives with higher antitumor activity, Diels-Alder reaction of **1** with maleic acid anhydride **2** was introduced to get some analogues of cantharidin **3**, an antitumor medicine in clinical use.

**Figure 1**

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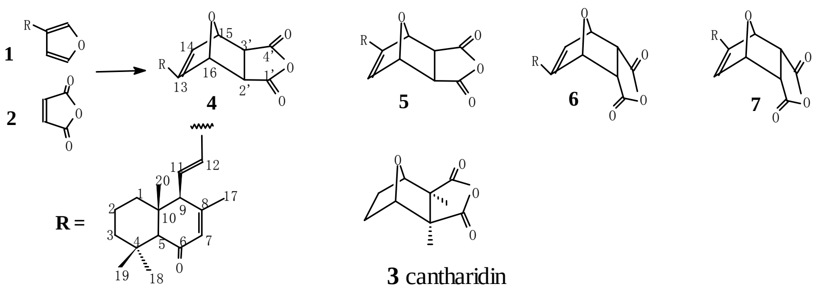


Reaction of **1** and excessive **2** at 0℃ in chloroform gave two thermodynamically dominated *exo* adducts **4** and **5**, together with a mixture of two kinetically dominated *endo* adducts **6** and **7.** When the reaction was conducted at 105℃ in toulene solution, the adducts were exclusively **4** and **5**, with no trace of **6** and **7** observed. It is evident that high temperature favours the formation of *exo* adducts.

The structures of **4**,**5** as well as **6**,**7** were determined by spectral methods. NMR data of **4**~**7** were listed in Table1,2. Whether a product is an *exo* adduct or an *endo* one, can be deduced from $J_{16\text{-}2}$ and $J_{15\text{-}3'}$ in $^1$H NMR spectrum($J_{16\text{-}2'}$ and $J_{15\text{-}3'}$: 0.0~2.0 Hz, *exo*; $J_{16\text{-}2'}$ and $J_{15\text{-}3'}$:3.0~4.0 Hz, *endo*).

**Table 1** $^{13}$C NMR data of **4~7**

| C | **4** | **5** | **6**&**7** | C | **4** | **5** | **6**&**7** |
|---|---|---|---|---|---|---|---|
| 1 | 40.5 | 40.2 | 40.2, 39.8 | 13 | 147.9 | 147.8 | 148.0 |
| 2 | 18.0 | 17.9 | 18.1 | 14 | 125.7 | 125.7 | 126.0, 126.1 |
| 3 | 43.1 | 43.1 | 43.3 | 15 | 83.3 | 83.3 | 83.3, 82.0 |
| 4 | 32.5 | 32.4 | 32.5 | 16 | 81.9 | 81.9 | 80.9, 80.5 |
| 5 | 61.3 | 61.2 | 61.7, 61.3 | 17 | 22.8 | 22.7 | 22.8 |
| 6 | 199.4 | 199.5 | 200.0, 99.5 | 18 | 33.5 | 33.5 | 33.6 |
| 7 | 128.5 | 128.5 | 128.5 | 19 | 21.6 | 21.6 | 21.7 |
| 8 | 155.4 | 155.5 | 155.3 | 20 | 15.9 | 15.8 | 15.9, 15.7 |
| 9 | 63.2 | 63.2 | 63.5, 63.4 | 1’ | 169.9 | 170.1 | 168.2 |
| 10 | 42.7 | 42.8 | 43.0, 42.7 | 2’ | 51.0 | 50.9 | 49.5 |
| 11 | 132.1 | 132.2 | 136.4 | 3’ | 48.7 | 48.7 | 47.6 |
| 12 | 130.8 | 130.8 | 134.2 | 4’ | 169.4 | 169.5 | 167.0 |

**Table 2** $^1$H NMR data of **4~7**

| H | **4** | **5** | **6**&**7** |
|---|---|---|---|
| 5 | 2.04(s) | 2.03(s) | 2.01(s), 2.02(s) |
| 7 | 5.85(s) | 5.84(s) | 5.84(s) |
| 9 | 2.90(d, J=10.0 Hz) | 2.88(d, J=10.1 Hz) | 2.85(d, J=10.3 Hz) |
| 11 | 5.75(dd, J=10.0, 15.8 Hz) | 5.75(dd, J=10.1, 15.9 Hz) | 5.74(dd, J=10.3, 15.8 Hz) |
| 12 | 6.22(d, J=15.8 Hz) | 6.21(d, J=15.9 Hz) | 6.25(d, J=15.8 Hz) |
| 14 | 6.26(d, J=1.8 Hz) | 6.25(d, J=1.8 Hz) | 6.30(s) |
| 15 | 5.44(d, J=1.8 Hz) | 5.42(d, J=1.8 Hz) | 5.41(d, J=5.2 Hz) |
| 16 | 5.53(s) | 5.51(s) | 5.55(d, J=5.4 Hz) |
| 17 | 1.76(s) | 1.74(s) | 1.74(s) |
| 18 | 0.94(s) | 0.94(s) | 0.96(s) |
| 19 | 1.10(s) | 1.10(s) | 1.10(s) |
| 20 | 1.17(s) | 1.16(s) | 1.15(s) |
| 2’ | 3.30(d, J=6.9 Hz) | 3.30(d, J=6.9 Hz) | 3.93(dd, J=5.4, 8.2 Hz) |
| 3’ | 3.10(d, J=6.9 Hz) | 3.10(d, J=6.9 Hz) | 3.86(dd, J=5.4, 8.2 Hz) |

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## References

1. Q. Zhao, X. J. Hao, Y. Z. Chen, C. Zou, *Acta Pharmaceutica Sinica*, **1995**, *302*, 119.

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