Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information for:

The multi-channel reaction of OH radical with 5-hydroxymethylcytosine: a computational study

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Captions:

Table S1 The relevant information of different 5-hmCyt tautomers and their isomerization reactions both in the gas and aqueous Phases

Table S2 The energy information for the addition of •OH to C2, N3 and C4 sites of 5-hmCyt both in the gas and aqueous phases

Fig.S1 The energy profiles along the dihedral angle O3C7C5C4 (degree) in 5-hmCyt.

Fig.S2 Optimized corresponding structures along the energy profiles for 5-hmCyt.

Fig.S3 The minimum energy path of path R5.

Fig.S4 The minimum energy path of path R6.

Fig. S5 Optimized structures (bond distances in Å) in the aqueous phase for the addition reaction of •OH mediated 5-hmCyt (paths R1 and R2) at the CBS-QB3 composite approach.

Fig. S6 Optimized structures (bond distances in Å) in the aqueous phase for the hydrogen-abstraction reaction (the H3 and H4 of NH_2 group, the H7 of cyclic C6 atom) of •OH mediated 5-hmCyt (paths R3, R4, R7) at the CBS-QB3 composite approach.

Fig. S7 Optimized structures (bond distances in Å) in the aqueous phase for the hydrogen-abstraction reaction (the H5 and H6 of C7 atom, H8 of O3 atom) of •OH mediated 5-hmCyt (paths R5, R6, R8) at the CBS-QB3 composite approach.

Table content:

Table S1 The relevant information of different 5-hmCyt tautomers and their isomerization reactions both in the gas and aqueous Phases

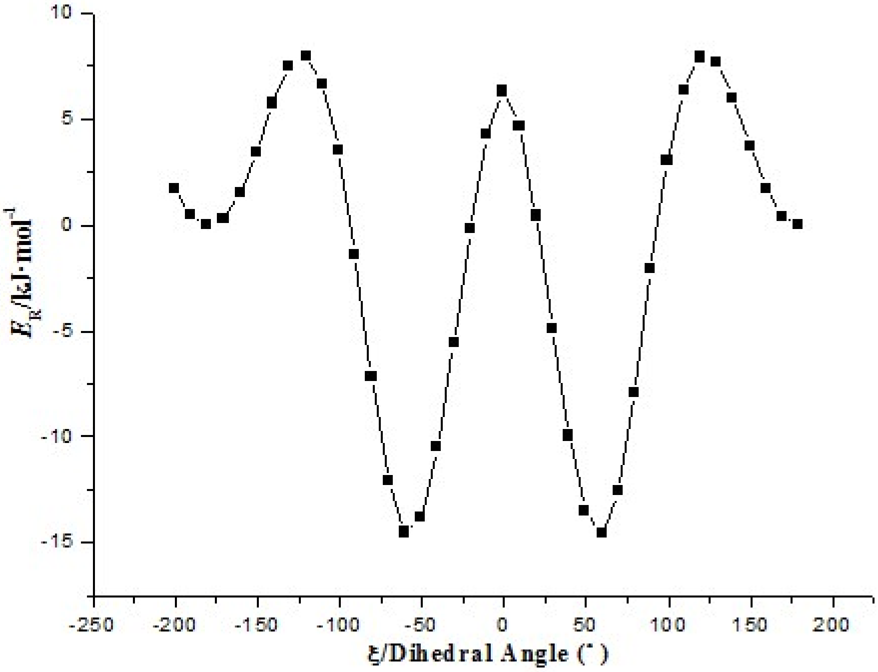
Species	ΔG^{g}/(kJ·mol^{-1})	$\Delta G^{g\neq}$/(kJ·mol^{-1})	ΔG^{s}/(kJ·mol^{-1})	$\Delta G^{s\neq}$/(kJ·mol^{-1})
M1	6.00		1.67	
M2	0.00		0.00	0.00
M3	0.00		0.00	0.00
TSM1/M2	18.78		13.04	
TSM2/M3	18.82		17.39	
TSM3/M1	18.82		13.04	
M1→M2		12.78		11.37
M2→M3		18.82		17.39
M3→M1		18.82		13.04

ΔG^{g} and $\Delta G^{g\neq}$ are relative free energy and activation free energy in the gas phase, respectively; ΔG^{s} and $\Delta G^{s\neq}$ are relative free energy and activation free energy with PCM model based on the optimized geometries in the aqueous phase.

Table S2 The energy information [a] (kJ·mol^{-1}) for the addition of •OH to C2, N3 and C4 sites of 5-hmCyt both in the gas and aqueous phases

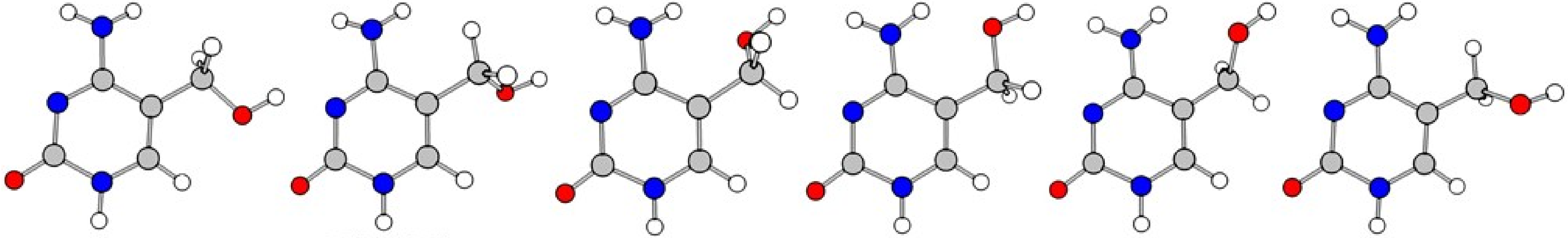
Species	CBS-QB3[b]			PCM[c]	
	ΔE^{g}	ΔG^{g}	$\Delta G^{g\neq}$	ΔG^{s}	$\Delta G^{s\neq}$
			Addition Reactions		
R[d]	0.00	0.00		0.00	
C2-IM	-24.08	9.79		28.79	
C2-TS	34.41	75.37		99.19	
C2-P	7.43	46.45		70.58	
N3-IM	-25.72	6.27		23.57	
N3-TS	34.26	73.07		101.18	
N3-P	21.64	57.52		97.54	
C4-IM	-25.45	8.85		23.56	
C4-TS	18.03	55.95		75.56	
C4-P	-23.60	13.16		41.51	
C2-IM→C2-P			65.58		70.40
N3-IM→N3-P			66.80		77.61
C4-IM→C4-P			47.10		52.00

[a] ΔE^{g}, ΔG^{g}, and $\Delta G^{g\neq}$ are relative energy, relative free energy, and activation free energy in the gas phase, respectively; ΔG^{s} and $\Delta G^{s\neq}$ are relative free energy and activation free energy with PCM model based on the optimized geometries in the aqueous phase. [b] CBS-QB3 composite approach. [c] CBS-QB3 with PCM model. [d] denotes 5-hmCyt+•OH.



E_R/kJ·mol^{-1}
10
5
0
-5
-10
-15
-250
-200
-150
-100
-50
0
50
100
150
200
ξ/Dihedral Angle (°)

Fig. S1



M1 TSM1/M2 M2 TSM2/M3 M3 TSM3/M1

Fig. S2

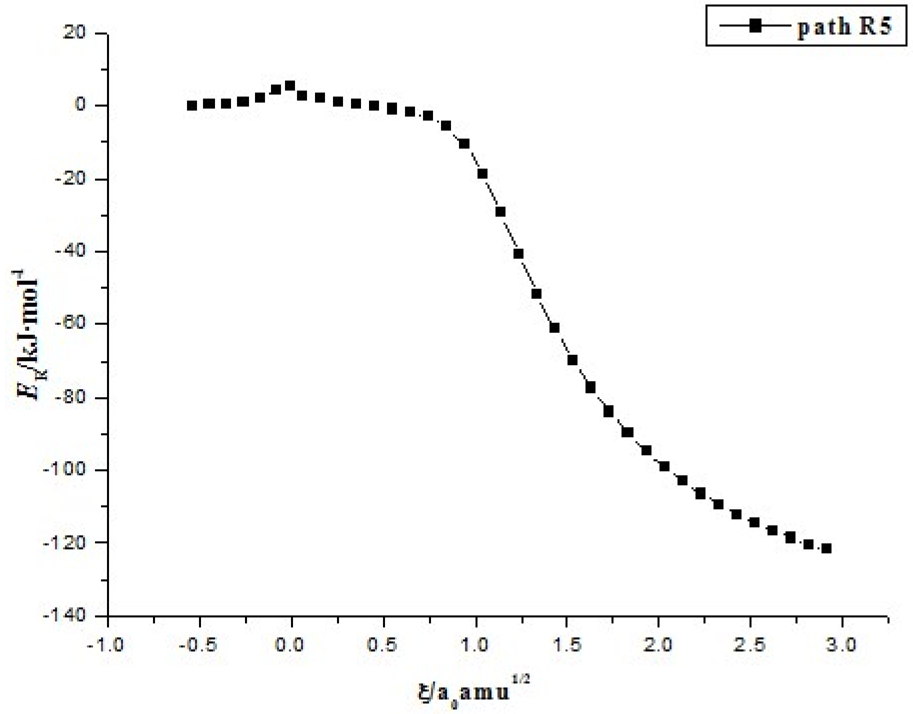
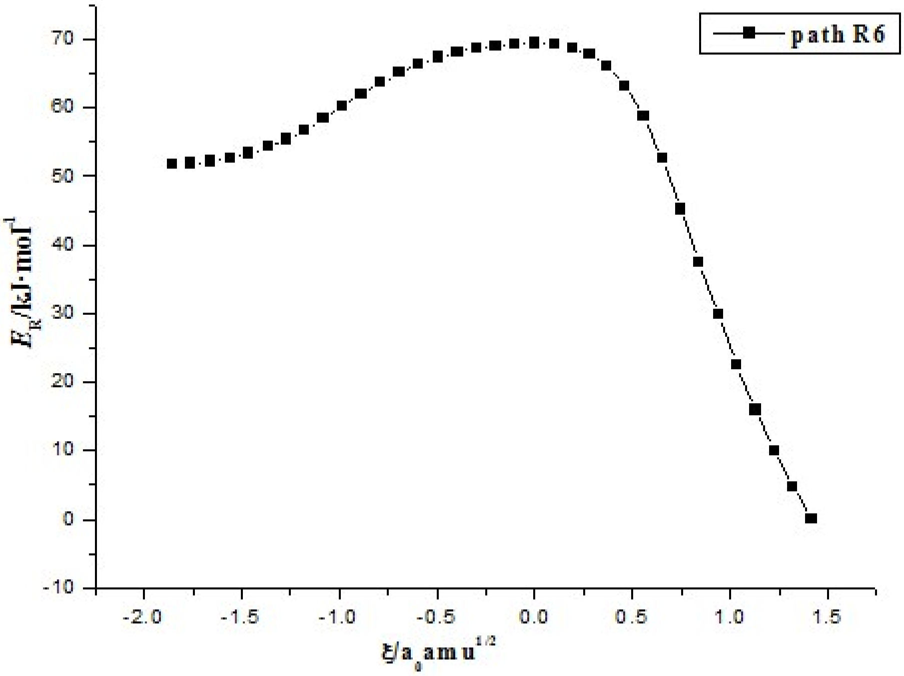

path R5
E_R/kJ·mol^{-1}
20
0
-20
-40
-60
-80
-100
-120
-140
-1.0
-0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
ξ/$a_0$amu$^{1/2}$

Fig. S3



path R6
E_R/kJ·mol^{-1}
70
60
50
40
30
20
10
0
-10
-2.0
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5
ξ/a$_0$amu$^{1/2}$

Fig. S4

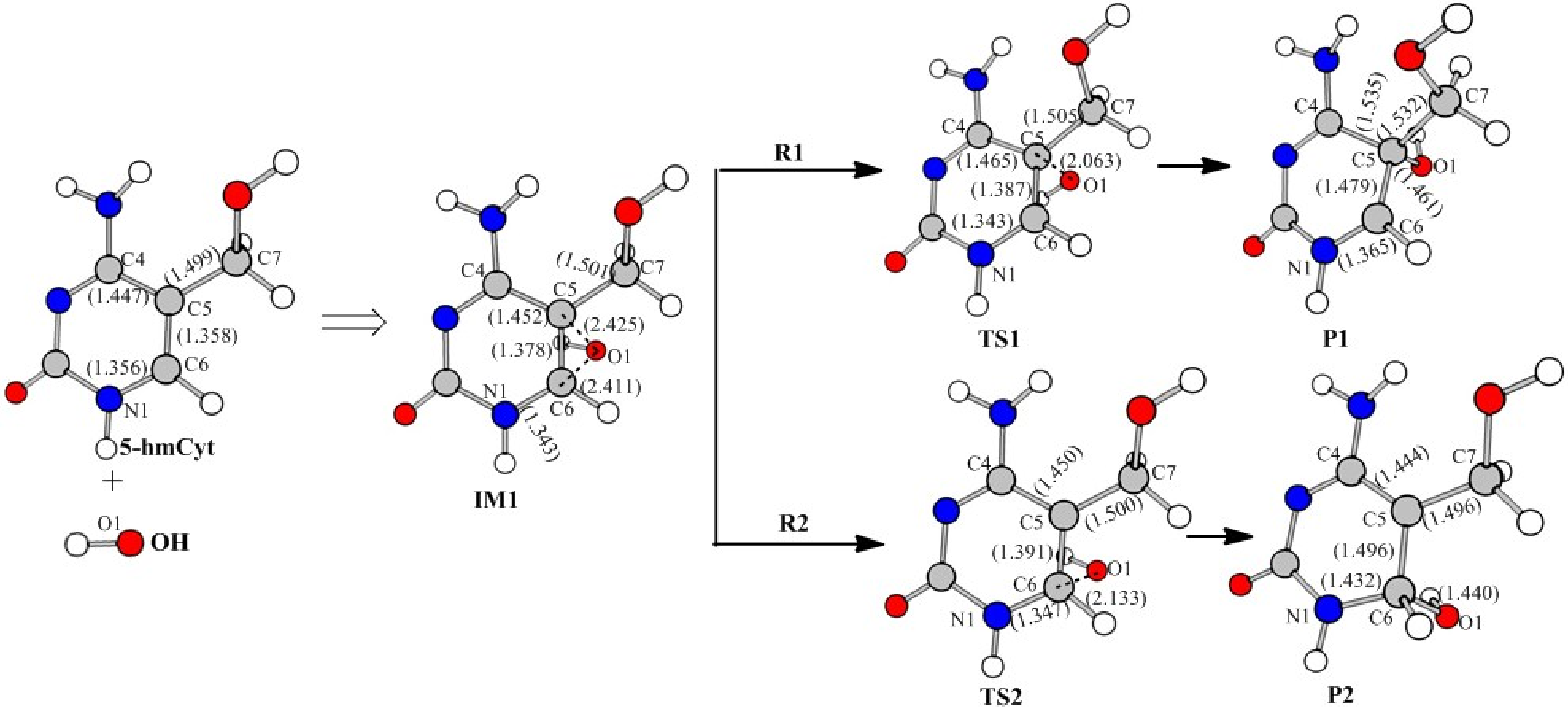

5-hmCyt
+
O1
OH
C4
C5
C6
C7
N1
(1.499)
(1.447)
(1.358)
(1.356)
IM1
(1.501)
(1.452)
(2.425)
(1.378)
O1
(2.411)
(1.343)
R1
R2
TS1
(1.505)
(1.465)
(2.063)
(1.387)
(1.343)
P1
(1.535)
(1.532)
(1.479)
(1.461)
(1.365)
TS2
(1.450)
(1.500)
(1.391)
(2.133)
(1.347)
P2
(1.444)
(1.496)
(1.496)
(1.432)
(1.440)

Fig. S5

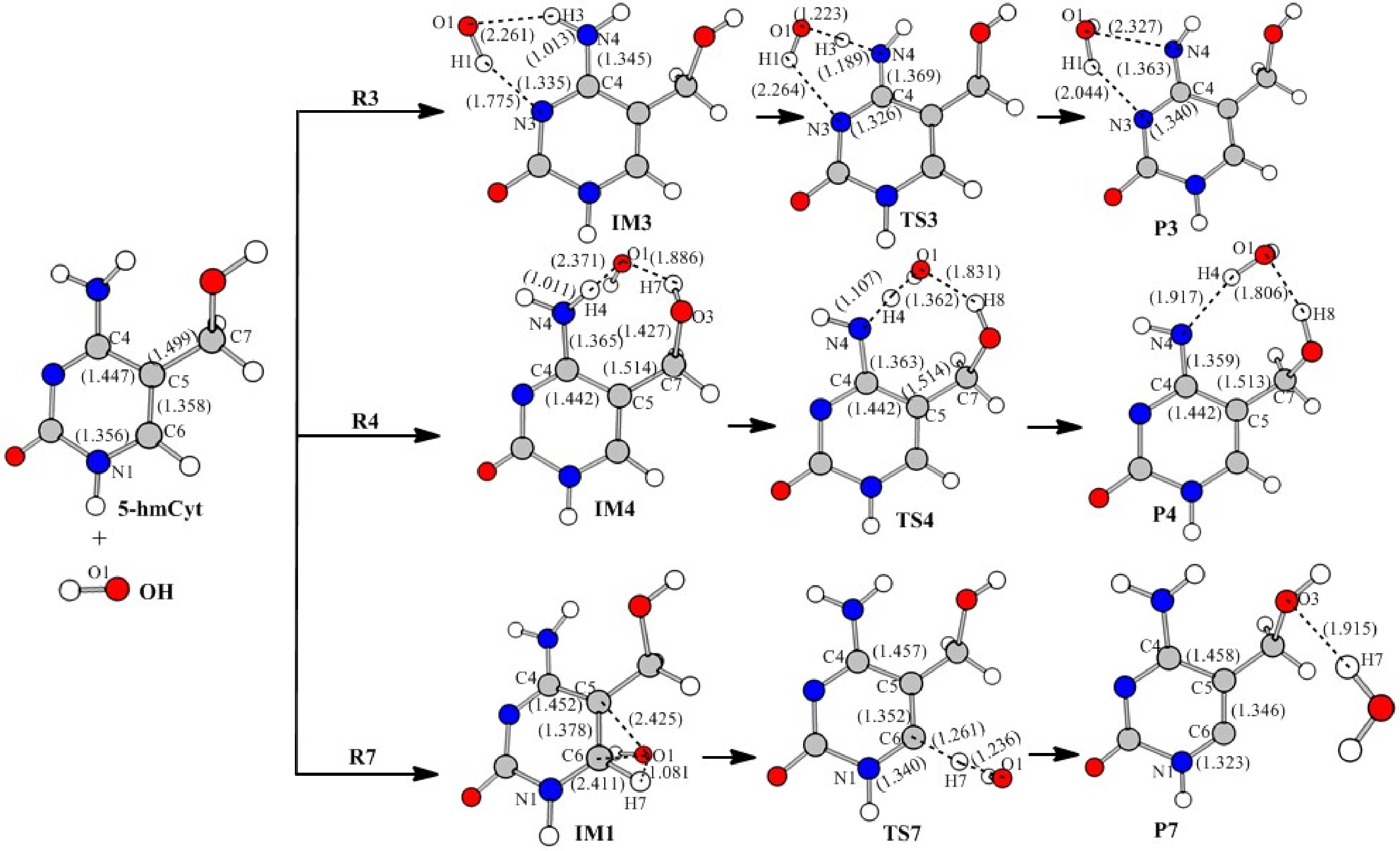

5-hmCyt
+
OH
O1
C4
C5
C6
C7
N1
(1.447)
(1.499)
(1.358)
(1.356)
R3
R4
R7
IM3
O1
H1
H3
N4
N3
C4
(2.261)
(1.013)
(1.345)
(1.335)
(1.775)
TS3
O1
H1
H3
N4
N3
C4
(1.223)
(1.189)
(1.369)
(2.264)
(1.326)
P3
O1
H1
N4
N3
C4
(2.327)
(1.363)
(2.044)
(1.340)
IM4
O1
H4
H7
O3
N4
C4
C5
C7
(2.371)
(1.886)
(1.011)
(1.427)
(1.365)
(1.514)
(1.442)
TS4
O1
H4
H8
N4
C4
C5
C7
(1.107)
(1.831)
(1.362)
(1.363)
(1.514)
(1.442)
P4
O1
H4
H8
N4
C4
C5
C7
(1.917)
(1.806)
(1.359)
(1.513)
(1.442)
IM1
C4
C5
C6
O1
H7
N1
(1.452)
(2.425)
(1.378)
1.081
(2.411)
TS7
C4
C5
C6
H7
O1
N1
(1.457)
(1.352)
(1.261)
(1.236)
(1.340)
P7
O3
H7
C4
C5
C6
N1
(1.458)
(1.915)
(1.346)
(1.323)

Fig. S6

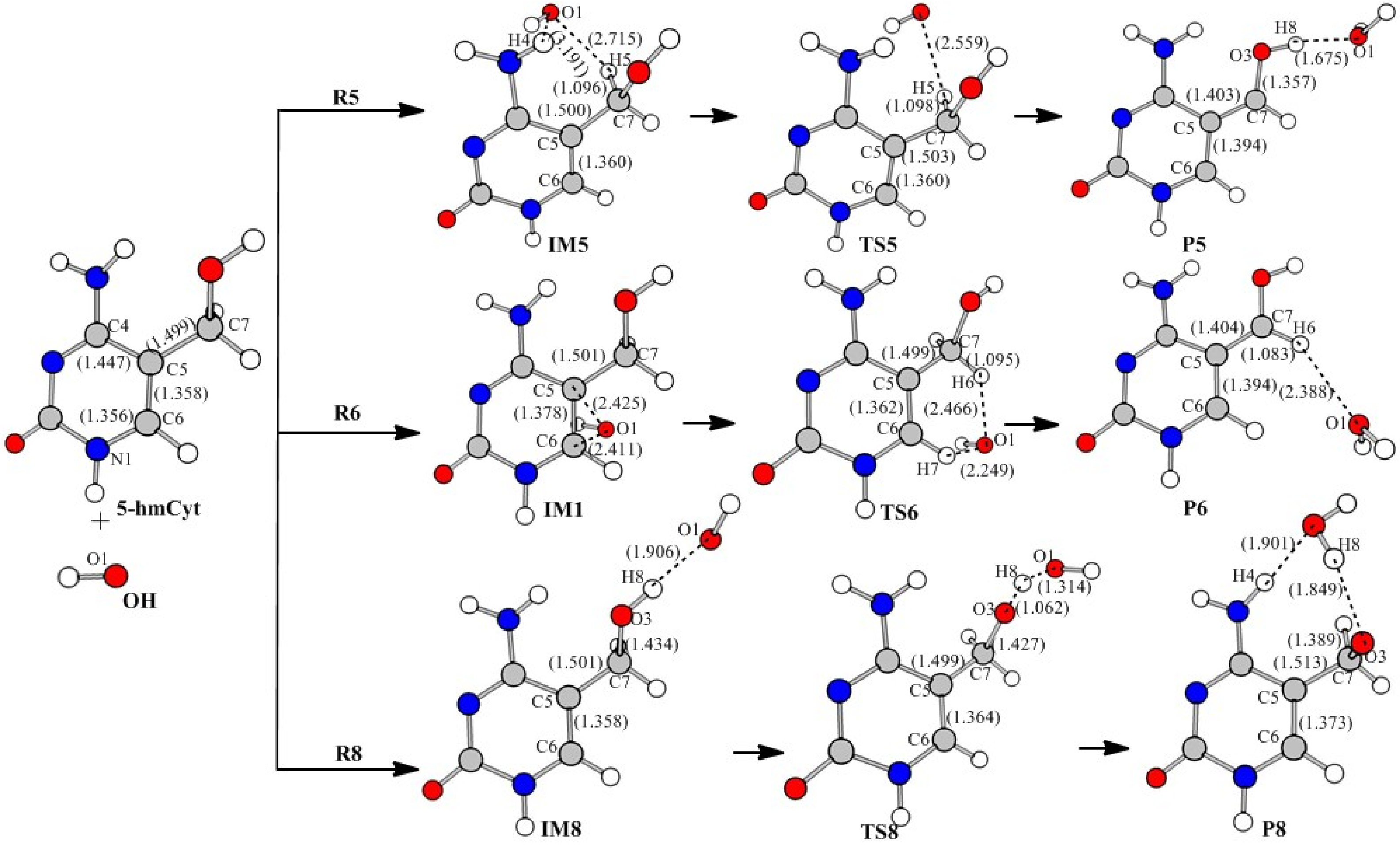

C4
(1.499)
C7
(1.447)
C5
(1.358)
(1.356)
C6
N1
5-hmCyt
+
O1
OH
R5
R6
R8
O1
H4
(2.715)
(1.911)
H5
(1.096)
(1.500)
C7
C5
(1.360)
C6
IM5
(2.559)
H5
(1.098)
C7
C5
(1.503)
C6
(1.360)
TS5
H8
O3
(1.675)
O1
(1.357)
(1.403)
C7
C5
(1.394)
C6
P5
(1.501)
C7
C5
(1.378)
(2.425)
O1
C6
(2.411)
IM1
C7
(1.499)
(1.095)
C5
H6
(1.362)
(2.466)
C6
O1
H7
(2.249)
TS6
C7
H6
(1.404)
(1.083)
C5
(1.394)
(2.388)
C6
O1
P6
O1
(1.906)
H8
O3
(1.434)
(1.501)
C7
C5
(1.358)
C6
IM8
H8
O1
(1.314)
O3
(1.062)
(1.427)
(1.499)
C7
C5
(1.364)
C6
TS8
(1.901)
H8
H4
(1.849)
(1.389)
(1.513)
O3
C7
C5
(1.373)
C6
P8

Fig. S7