SUPPORTING INFORMATION

Combined Experimental and Computational Study of the Thermochemistry of Methylpiperidines

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Procedure for Combustion Calorimetry Measurements:

Static bomb combustion calorimetry was used to measure the standard massic energies of combustion of the five liquid alkylpiperidines. The combustion bomb used was a twin-valve combustion bomb made by stainless steel and with an internal volume of 0.340 cm^3. A detailed description of the apparatus and the technique may be found in the literature[1,2].

The energy equivalent of the calorimeter and of the bomb (ε_{cal}) was determined from the combustion of benzoic acid (Sample BAS 693976/01) with a certified massic energy of combustion of the $\Delta_c u = -$ (26435.1 ± 3.5) J/g [3], under certified conditions. The conditions used in the certification of benzoic acid were the same used in all experiments carried out with the compounds studied in the present work. For 1-methylpiperidine, 3-methylpiperidine and 4-methylpiperidine, the value of the energy equivalent of the calorimeter was ε_{cal} = (15908.78 ± 0.77) J/K, as the average of 6 independent calibration experiments. For the compounds 2,6-dimethylpiperidine and 3,5-dimethylpiperidine, ε_{cal} = (15915.83 ± 0.76) J/K, which is the result of 8 independent calibration experiments with the same sample of benzoic acid. For both calibrations, ε_{cal} corresponds to average mass of water added to the calorimeter, Δm_{H_2O}, of 3119.6 g, and the uncertainty was the standard deviation of the mean. The calibration procedure was the same as previously described.[4]

The liquid samples were burnt in sealed polyester bags made of melinex (0.025 mm thickness), previously weighed, with a massic energy of combustion of dry melinex as $\Delta_c u^0 = -(22902 \pm 5)$ $J \cdot g^{-1}$.[5]. The mass of melinex used in each experiment was corrected for the mass fraction of water (w=0.0032) and the mass of CO_2 produced from it was calculated using a factor previously reported.[5]

The bomb, containing a volume of 1.00 cm^3 of water, was filled with oxygen until a pressure of 3.04 MPa, after it was purged twice to remove air. The calorimeter temperatures were measured to ± 10^{-4} K, at time intervals of 10 s, with a quartz thermometer, interfaced to a PC. For each experiment it was necessary to perform at least 100 readings for the initial period. After the ignition was made at T = (298.150 ± 0.001) K by discharge of 1400 μF capacitor through a platinum ignition wire of 0.05 mm

diameter, and 200 temperature readings were taken, 100 corresponding to the main period and 100 to the final period. The electrical energy of ignition was determined from the change of the potential difference across the capacitor when discharged through the platinum wire. The empirical formula and the massic energy of combustion of the cotton-thread are $CH_{1.686}O_{0.843}$ and $\Delta_c u^0 = -16250$ J·g^{-1},[4] respectively.

At the end of the experiment, the bomb was degasified slowly, with the gases passing through absorbent (carbosorb AS self-indicating) tubes, in order to recover the carbon dioxide resulted from the combustion experiment. From the total mass of carbon dioxide produced, the amount of substance used in each experiment was determined, taking into account the CO_2 formed from the cotton-thread and from the melinex bag. The small amounts of moisture present in the compounds 2,6-dimethylpiperidine and 3,5-dimethylpiperidne are expected to have a negligible effect on the energy of combustion, when this one is based on the amount of CO_2 formed.

The bomb was washed and the liquid titrated with NaOH to determine the amount of HNO_3 formed during the experiment. The correction for nitric acid formation was based on the molar energy of formation of 0.1 mol·dm^{-3} HNO_3 (aq), from N_2 (g), O_2 (g) and H_2O (l), $\Delta_f H^o_m = -59.7$ kJ·mol^{-1}.[6]

Detailed results of all combustion calorimetry experiments

Detailed results for each combustion experiment performed for each alkylpiperidine are given in Tables S1-S6. Symbols presented in these Tables have the follow meaning: $m(CO_2, \text{total})$ is the total mass of carbon dioxide recovered in the combustion; m(cpd) is the mass of compound burnt in each experiment; m(melinex) is the mass of melinex used to enclose the liquid compounds; m(fuse) is the mass of the cotton thread fuse; ΔT_{ad} is the adiabatic temperature rise; ε_f is the energy equivalent of the calorimeter including the contents of the bomb in the final state; $\Delta m(H_2O)$ is the deviation of the mass of water added to the calorimeter from 3119.6 g; ΔU(IBP) is the energy change for isothermal

combustion reaction under actual bomb conditions, with $\Delta U(\mathrm{IBP}) = -\{\varepsilon_{\mathrm{cal}} + \Delta m(\mathrm{H_2O})\, c_{\mathrm{p}}(\mathrm{H_2O},\ \mathrm{l}) + \varepsilon_{\mathrm{f}}\}\, \Delta T_{\mathrm{ad}}$; ΔU(melinex) is the energy of combustion of the melinex used in each experiment; ΔU(fuse) is the energy of combustion of the fuse (cotton); $\Delta U(\mathrm{HNO_3})$ is the energy correction for the nitric acid formation; ΔU(ign) is the electrical energy supplied for ignition; ΔU_{Σ} is the standard state correction; $\Delta_{\mathrm{c}} u^{\circ}$ is the massic energy of combustion of the compound.

Table S1 –Combustion experiments of 1-methylpiperidine, at T = 298.15 K

Experiment	1	2	3	4	5	6
$m(CO_2$, total)/ g	---	1.65560	---	1.56659	---	1.60906
m(cpd)/ g	0.57613	0.58517	0.57498	0.55608	0.49448	0.56078
m(melinex)/ g	0.04360	0.04011	0.03970	0.03535	0.04159	0.04859
m(fuse)/ g	0.00344	0.00352	0.00356	0.00312	0.00346	0.00290
ΔT_{ad} / K	1.57166	1.58929	1.56305	1.50632	1.35497	1.53767
ε_f / (J/K)	16.95	16.99	17.00	16.85	16.62	16.90
$\Delta m(H_2O)$/ g	0	+ 0.1	0	+ 0.1	+ 0.1	– 0.1
$-\Delta U$(IBP)/ J	25029.87	25311.36	24892.83	23989.75	21579.03	24487.82
ΔU(melinex)/ J	998.54	918.59	909.22	809.62	952.40	1112.77
ΔU(fuse)/ J	55.87	57.16	57.81	50.60	56.19	47.10
$\Delta U(HNO_3)$/ J	46.15	46.45	45.25	45.01	38.27	44.83
ΔU(ign)/ J	1.20	1.17	1.20	1.20	1.20	1.20
$-\Delta U$(carbon)/ J	0	0	0	0	0	0
ΔU_Σ / J	8.75	8.83	8.66	8.26	7.46	8.61
$-\Delta_c u^o$ / (J/g)	41517.30	41490.78	41515.69	41495.94	41505.24	41501.68
% CO_2	(99.939)	99.928	(99.939)	99.921	(99.939)	99.967
$<\Delta_c u^o>$ = –(41504.4 ± 4.3) J/g						

Table S2 –Combustion experiments of 3-methylpiperidine, at T = 298.15 K

Experiment	1	2	3	4	5	6
$m(CO_2$, total)/ g	1.68384	1.39328	---	---	1.42608	1.36071
m(cpd)/ g	0.58506	0.47946	0.46542	0.49185	0.48782	0.46523
m(melinex)/ g	0.5247	0.04856	0.04744	0.04724	0.05262	0.05053
m(fuse)/ g	0.00367	0.00340	0.00330	0.00433	0.00417	0.00388
ΔT_{ad} / K	1.59718	1.31759	1.27942	1.34862	1.34533	1.28369
ε_f / (J/K)	17.04	16.53	16.49	16.60	16.65	16.51
$\Delta m(H_2O)$/ g	– 0.1	– 0.1	0	0	0	0
$-\Delta U$(IBP)/ J	25435.76	20982.50	20375.13	21477.31	21424.99	20443.16
ΔU(melinex)/ J	1201.63	1112.08	1086.50	1081.93	1205.06	1157.31
ΔU(fuse)/ J	59.60	55.22	53.59	70.32	67.72	63.01
$\Delta U(HNO_3)$/ J	44.00	40.66	38.21	39.88	34.98	35.94
ΔU(ign)/ J	1.21	1.20	1.21	1.20	1.19	1.20
$-\Delta U$(carbon)/ J	0	0	0	0	0	0
ΔU_Σ / J	9.12	7.35	7.12	7.54	7.63	7.21
$-\Delta_c u^o$ / (J/g)	41226.88	41225.52	41228.35	41224.84	41220.96	41223.67
% CO_2	99.957	99.980	(99.973)	(99.973)	99.820	99.983
$<\Delta_c u^o>$ = –(41225.0 ± 1.0) J/g						

Table S3 –Combustion experiments of 4-methylpiperidine, at T = 298.15 K

Experiment	1	2	3	4	5	6	7	8
$m(CO_2$, total)/ g	---	---	1.39184	1.33623	1.45425	---	1.41803	1.27838
m(cpd)/ g	0.46526	0.56617	0.47751	0.45325	0.49871	0.44257	0.48777	0.43500
m(melinex)/ g	0.05028	0.04974	0.05014	0.05404	0.05262	0.05480	0.04953	0.04986
m(fuse)/ g	0.00384	0.00374	0.00346	0.00350	0.00366	0.00338	0.00365	0.00370
ΔT_{ad}/ K	1.28339	1.54401	1.31517	1.25745	1.37328	1.23092	1.34068	1.20440
ε_f/ (J/K)	16.26	17.02	16.29	16.43	16.66	16.20	16.36	16.13
$\Delta m(H_2O)$/ g	0	0	+ 0.1	+ 0.2	– 0.2	– 0.1	+ 0.1	+ 0.2
$-\Delta U$(IBP)/ J	20438.06	24589.63	20944.75	20026.23	21868.97	19601.89	21351.04	19180.49
ΔU(melinex)/ J	1151.60	1139.04	1148.41	1237.73	1205.06	1255.09	1134.24	1141.78
ΔU(fuse)/ J	62.36	60.74	56.19	56.84	59.44	54.89	59.28	60.09
$\Delta U(HNO_3)$/ J	38.09	41.37	41.73	38.86	38.86	33.91	39.76	35.88
ΔU(ign)/ J	1.19	1.20	1.20	1.20	1.20	1.20	1.20	1.20
$-\Delta U$(carbon)/ J	0	0	0	0	0	0	0	0
ΔU_Σ/ J	7.18	8.76	7.34	7.06	7.77	6.95	7.52	6.72
$-\Delta_c u^\circ$/ (J/g)	41219.19	41221.75	41234.49	41223.47	41219.63	41236.08	41226.48	41229.47
% CO_2	(100.002)	(100.002)	99.960	100.063	99.802	(100.002)	99.784	99.984
$<\Delta_c u^\circ>$ = –(41226.3 ± 2.3) J/g								

Table S4 –Combustion experiments of 2,6-dimethylpiperidine, at T = 298.15 K

Experiment	1	2	3	4	5	6	7
$m(CO_2$, total)/ g	1.31206	1.38843	1.81989	1.54106	1.58197	1.72251	1.59834
m(cpd)/ g	0.44740	0.47651	0.63610	0.53069	0.54663	0.59656	0.55576
m(melinex)/ g	0.03940	0.03822	0.03693	0.04057	0.03929	0.04142	0.03573
m(fuse)/ g	0.00264	0.00254	0.00261	0.00244	0.00271	0.00258	0.00253
ΔT_{ad} / K	1.23771	1.31247	1.72938	1.45722	1.49767	1.63252	1.51645
ε_f / (J/K)	16.40	16.56	17.26	16.82	16.86	17.09	16.86
$\Delta m(H_2O)$/ g	0	+ 0.1	+ 0.1	+ 0.1	0	+ 0.1	0
$-\Delta U$(IBP)/ J	19719.44	20911.29	27555.04	23217.94	23861.87	26011.44	24161.08
ΔU(melinex)/ J	902.37	875.41	845.71	929.10	899.85	948.51	818.30
ΔU(fuse)/ J	42.87	41.25	42.39	39.63	44.01	41.90	41.09
$\Delta U(HNO_3)$/ J	38.86	36.54	46.69	43.76	41.97	44.42	45.61
ΔU(ign)/ J	1.13	1.13	1.16	1.16	1.14	1.17	1.16
$-\Delta U$(carbon)/ J	0	0	0	0	0	0	0
ΔU_Σ / J	6.67	7.09	9.57	7.93	8.18	9.04	8.23
$-\Delta_c u^o$ / (J/g)	41858.61	41866.63	41832.29	41825.47	41832.17	41850.61	41828.65
% CO_2	99.306	99.701	99.784	99.809	99.824	99.622	99.662
$<\Delta_c u^o>$ = –(41842.1 ± 6.2) J/g							

Table S5 –Combustion experiments of 3,5-dimethylpiperidine, at T = 298.15 K

Experiment	1	2	3	4	5	6
$m(CO_2$, total)/ g	1.77696	1.85654	1.66364	1.45253	1.88099	1.96022
m(cpd)/ g	0.61511	0.64565	0.57089	0.50352	0.65433	0.68048
m(melinex)/ g	0.04315	0.04177	0.04616	0.03408	0.04115	0.04535
m(fuse)/ g	0.00258	0.00235	0.00265	0.00260	0.00277	0.00279
ΔT_{ad}/ K	1.68285	1.76138	1.57104	1.37763	1.78506	1.85948
ε_f/ (J/K)	16.95	17.06	16.75	16.66	17.35	17.24
$\Delta m(H_2O)$/ g	− 0.1	0	0	+ 0.1	+ 0.1	+ 0.1
$-\Delta U$(IBP)/ J	26811.72	28063.82	25030.67	21935.70	28424.34	29609.17
ΔU(melinex)/ J	988.26	956.51	1057.25	780.60	942.35	1038.52
ΔU(fuse)/ J	41.90	38.16	43.04	42.22	44.98	45.31
$\Delta U(HNO_3)$/ J	45.13	50.15	43.10	38.09	52.54	49.25
ΔU(ign)/ J	1.14	1.13	0.96	1.18	1.17	1.15
$-\Delta U$(carbon)/ J	0	0	0	0	0	0
ΔU_Σ/ J	9.39	9.84	8.71	7.40	9.90	10.48
$-\Delta_c u^\circ$/ (J/g)	41823.25	41830.76	41825.24	41837.88	41834.24	41829.97
% CO_2	99.610	99.501	99.816	99.956	99.958	99.960
$<\Delta_c u^\circ>$ = –(41830.2 ± 2.2) J/g						

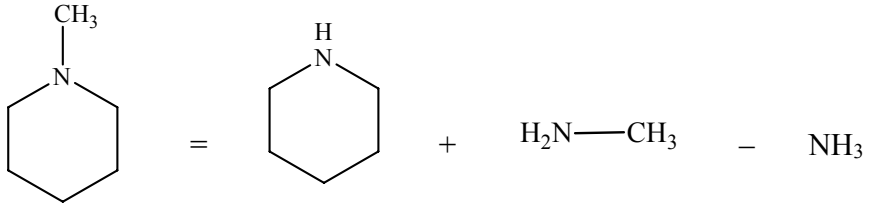
Procedure for Vaporization Calorimetry Measurements:

The enthalpies of vaporization of the five liquid alkylpiperidines were measured by the "vacuum sublimation" drop microcalorimetric method[7,8] using a Calvet High Temperature Microcalorimeter with a sensitivity of 3 μV·mW, held at T = 326 K for the isomers of methylpiperidine and at T = 334 K for the two dimethylpiperidines. Samples, about 4-6 mg of each compound, contained in a thin glass capillary tube sealed at one end, were dropped, at room temperature, into the hot reaction vessel, and then removed from the hot zone by vacuum sublimation. From the observed enthalpy of vaporization, the standard molar enthalpy of vaporization at T = 298.15 K was calculated using a value $\Delta_{298\mathrm{K}}^{T} H_{\mathrm{m}}^{0}(\mathrm{g})$ estimated by a group scheme based on values of Messerly *et al* [9] and of Stull *et al*[10],

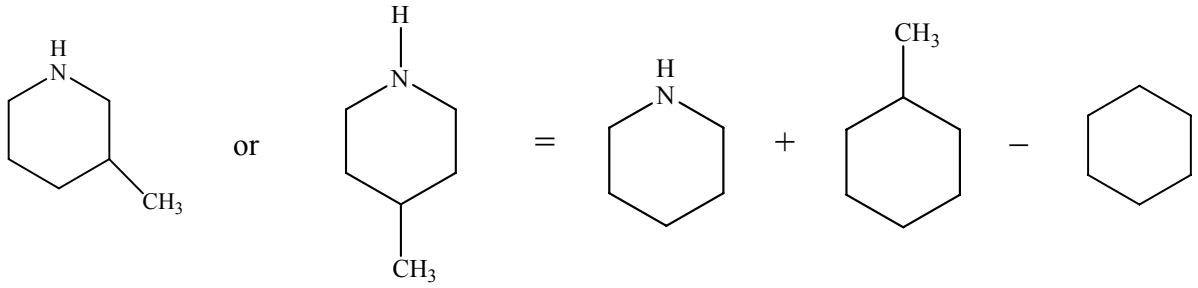
Calibration of Calvet microcalorimeter for vaporization experiments

The calibration of the calorimeter was made with *n*-undecane, 99+, by the same experimental procedure as with the compounds, and using the value of $\Delta_{\mathrm{l}}^{\mathrm{g}} H_{\mathrm{m}}^{\mathrm{o}}$ = (56.580 ± 0.566) kJ·mol^{-1} for the standard molar enthalpy of vaporization of the *n*-undecane at T = 298.15 K.[11] From 5 independent experiments, the value of the calibration constant of the calorimeter was found to be k_{cal} (T = 334 K)= (1.0134 ± 0.0075), with the uncertainty as the standard deviation of the mean. This value was used in the calculation of standard molar enthalpy of vaporization of 1-methyl, 3-methyl and 4-methylpiperidine compounds. For the 2,6-dimethyl and 3,5-dimethylpiperidines, k_{cal} (T = 326 K)= (1.0607 ± 0.0020), also determined from 5 independent experiments.

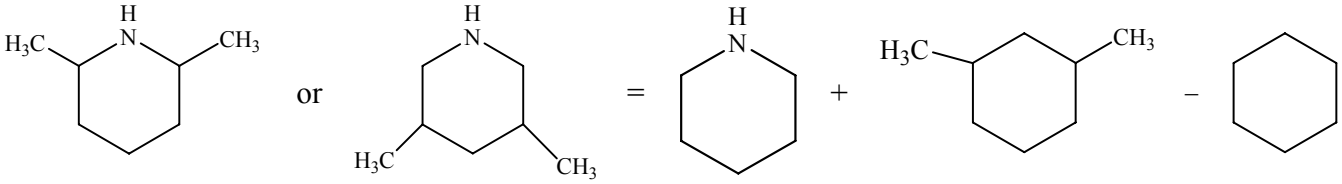
Schemes used for the estimation of $\Delta_{298\mathrm{K}}^{T} H_{\mathrm{m}}^{0}(\mathrm{g})$



Scheme 1- Group scheme for $\Delta_{298\mathrm{K}}^{T} H_{\mathrm{m}}^{0}(\mathrm{g})$ estimation, for 1-methylpiperidine



Scheme 2- Group scheme for $\Delta_{298K}^{T} H_{m}^{0}(g)$ estimation, for 3-methylpiperidine and 4-methylpiperidine



Scheme 3- Group scheme for $\Delta_{298K}^{T} H_{m}^{0}(g)$ estimation, for 2,6- and 3,5-dimethylpiperidines

Table S6.- Microcalorimetric standard (p^{o} = 0.1MPa) molar enthalpies of vaporization, at T = 298.15 K.

Compound	Number of Experiments	T / K	$\frac{\Delta_{l,298.15K}^{g,T} H_{m}^{o}}{kJ \cdot mol^{-1}}$	$\frac{\Delta_{298.15K}^{T} H_{m}^{o}(g)}{kJ \cdot mol^{-1}}$	$\frac{\Delta_{l}^{g} H_{m}^{o}(T = 298.15K)}{kJ \cdot mol^{-1}}$
1-Methyl	5	334.1	41.48 ± 0.15	4.68	36.80 ± 0.61
3-Methyl	5	334.3	49.63 ± 0.16	5.22	44.41 ± 0.72
4-Methyl	5	334.4	45.81 ± 0.37	5.25	40.56 ± 0.89
2,6-Dimethyl	5	326.6	47.15 ± 0.37	4.77	42.38 ± 0.68
3,5-Dimethyl	5	326.6	53.88 ± 0.35	4.77	49.11 ± 0.60

Table S7.- Full-optimized geometries and enthalpies at T = 298.15 K computed at the MP2/6-31G(d) level of theory for piperidine and the four methylpiperidine isomers.

Compound	Optimized Geometry / Å	Enthalpy / a.u.
Piperidine	C -0.712197 -1.256229 -0.228960 C 0.745799 -1.207445 0.214264 N 1.370809 -0.001292 -0.330799 C 0.748082 1.206039 0.214264 C -0.709824 1.257568 -0.228959 C -1.450004 0.001368 0.231931 H 2.363835 -0.002237 -0.098157 H 0.789010 1.240838 1.320372 H 1.294628 2.077583 -0.162230 H -1.191105 2.158979 0.169079 H -0.736403 1.321968 -1.322778 H -1.508684 0.001421 1.329147 H -2.481364 0.002340 -0.139534 H -1.195173 -2.156726 0.169091 H -0.738903 -1.320589 -1.322778 H 0.786659 -1.242324 1.320372 H 1.290699 -2.080021 -0.162229	-250.838608
1-Methylpiperidine	C 1.884577 -0.000008 0.246567 C 1.148332 -1.250264 -0.228784 C -0.315394 -1.200104 0.192069 N -0.962076 -0.000060 -0.334467 C -0.315546 1.200119 0.191913 C 1.148307 1.250321 -0.228644 H -0.852523 -2.073652 -0.195559 C -2.380492 -0.000059 -0.007623 H -0.852678 2.073612 -0.196028 H -0.385835 1.239073 1.299243	-289.974139

	H 1.193881 1.313222 -1.322029 H 1.617099 2.156285 0.174028 H 2.921019 0.000052 -0.110354 H 1.925670 -0.000057 1.344383 H 1.193671 -1.312964 -1.322193 H 1.617213 -2.156315 0.173611 H -0.385378 -1.238723 1.299384 H -2.853239 0.886991 -0.438923 H -2.853284 -0.887042 -0.439012 H -2.569783 -0.000089 1.081731	
2-Methylpiperidine	C 1.226239 1.224174 0.208127 C 1.867909 -0.067675 -0.296164 C 1.077569 -1.272227 0.198919 N -0.308978 -1.155349 -0.258272 C -0.980406 0.010917 0.323290 C -0.257074 1.265299 -0.159770 H 1.496564 -2.200121 -0.205637 H -0.821475 -1.996319 0.012292 H -0.923565 -0.004616 1.431184 C -2.443453 0.003619 -0.091437 H -0.367790 1.319734 -1.250227 H -0.737605 2.154494 0.267418 H 1.747295 2.099571 -0.197060 H 1.327900 1.273654 1.300973 H 1.867044 -0.078688 -1.392177 H 2.910394 -0.139292 0.036813 H 1.156455 -1.325798 1.301871 H -2.966478 0.876182 0.311561 H -2.517170 0.018095 -1.182315 H -2.953425 -0.894094 0.275418	-289.981570
3-Methylpiperidine	C -0.262115 -1.231363 0.144115	-289.978778

	N 1.127748 -1.196503 -0.312863 C 1.847034 -0.068700 0.281190 C 1.212943 1.229231 -0.203355 C -0.271798 1.262023 0.159638 C -0.999151 0.013393 -0.343405 H 1.589238 -2.067166 -0.049179 H 1.826492 -0.088939 1.388106 H 2.895988 -0.124139 -0.029917 H 1.735997 2.089064 0.232509 H 1.329834 1.286465 -1.291550 H -0.375973 1.310607 1.253828 H -0.749153 2.164737 -0.242231 C -2.461143 -0.001111 0.090020 H -0.947862 0.004367 -1.440609 H -0.346531 -1.279410 1.248555 H -0.738532 -2.132319 -0.260359 H -2.981044 -0.885455 -0.293142 H -2.540437 -0.008804 1.182737 H -2.986861 0.885668 -0.277930	
4-Methylpiperidine	C -1.203794 1.205031 0.193226 N -1.798273 -0.000003 -0.386445 C -1.203789 -1.205037 0.193227 C 0.276833 -1.249995 -0.166087 C 1.004161 0.000008 0.333469 C 0.276829 1.250002 -0.166086 H -2.802432 -0.000006 -0.206786 H -1.308558 -1.241438 1.294899 H -1.723496 -2.078934 -0.214872 H 0.739576 -2.151677 0.255630 H 0.369254 -1.309931 -1.257914 H 0.949368 0.000001 1.433470 C 2.473315 -0.000003 -0.075205	-289.978984

	H 0.739559 2.151688 0.255637 H 0.369255 1.309947 -1.257913 H -1.308557 1.241430 1.294899 H -1.723504 2.078928 -0.214870 H 2.990285 0.886422 0.307019 H 2.990365 -0.886225 0.307379 H 2.565464 -0.000219 -1.166724	

Table S8.- Full-optimized geometries and enthalpies at T = 298.15 K computed at the BP86/6-31G(d) level of theory for piperidine and the four methylpiperidine isomers.

Compound	Optimized Geometry / Å	Enthalpy / a.u.
Piperidine	C -0.759283 1.213037 0.210486 N -1.384804 -0.004941 -0.328096 C -0.750582 -1.218380 0.210566 C 0.722442 -1.265177 -0.228378 C 1.464053 0.005167 0.232442 C 0.713465 1.270262 -0.228294 H -2.382857 -0.008441 -0.084242 H -0.791848 -1.266428 1.329545 H -1.297330 -2.098826 -0.174970 H 1.207410 -2.171947 0.179959 H 0.757793 -1.336802 -1.332430 H 1.528538 0.005326 1.340330 H 2.504177 0.008907 -0.144506 H 1.191845 2.180385 0.180325 H 0.748528 1.342355 -1.332333 H -0.801105 1.261064 1.329444 H -1.312092 2.089542 -0.175388	-251.729017
1-Methylpiperidine	C 1.902817 0.000027 0.246590 C 1.159478 -1.260755 -0.229154 C -0.318488 -1.211465 0.189172 N -0.974063 -0.000091 -0.322327 C -0.318689 1.211388 0.189017 C 1.159400 1.260871 -0.229046 H -0.860150 -2.089153 -0.211635 C -2.399898 -0.000047 -0.010486 H -0.860439 2.089082 -0.211873 H -0.389793 1.270293 1.308229	-291.009702

	H 1.212959 1.329979 -1.332607 H 1.628335 2.174475 0.182307 H 2.947787 0.000125 -0.116116 H 1.949826 -0.000041 1.355041 H 1.212824 -1.329750 -1.332739 H 1.628490 -2.174422 0.182004 H -0.389378 -1.270020 1.308281 H -2.877104 0.894484 -0.450004 H -2.877008 -0.895028 -0.449163 H -2.615634 0.000496 1.088003	
2-Methylpiperidine	C 1.240056 1.233959 0.207835 C 1.886065 -0.070613 -0.295349 C 1.082325 -1.285093 0.194777 N -0.313238 -1.165976 -0.255754 C -0.990285 0.011005 0.321948 C -0.256084 1.278022 -0.159673 H 1.502517 -2.220435 -0.218819 H -0.829818 -2.011004 0.021618 H -0.935889 0.000796 1.442650 C -2.465579 0.005427 -0.093027 H -0.369362 1.345582 -1.259884 H -0.738465 2.172736 0.278538 H 1.766634 2.116095 -0.202601 H 1.344609 1.287921 1.311200 H 1.898260 -0.078336 -1.402194 H 2.934199 -0.148402 0.050320 H 1.172572 -1.346763 1.309714 H -2.993353 0.884916 0.316631 H -2.554056 0.021432 -1.193928 H -2.984167 -0.898950 0.277963	-291.015025
3-Methylpiperidine	C -0.985567 0.745233 -0.324518	-291.012588

	N -1.001388 0.729719 1.146223 C 0.361636 0.735131 1.698893 C 1.090918 -0.544675 1.261187 C 1.100873 -0.661189 -0.275500 C -0.321759 -0.537618 -0.863903 H -1.508324 1.556112 1.486131 H 0.960576 1.621147 1.364083 H 0.291783 0.784162 2.801338 H 2.123498 -0.544378 1.658578 H 0.566646 -1.416030 1.698116 H 1.730646 0.150375 -0.698573 H 1.564330 -1.615727 -0.591941 C -0.313677 -0.565862 -2.399693 H -0.923382 -1.391389 -0.490519 H -0.434048 1.627532 -0.743531 H -2.029704 0.812731 -0.684475 H -1.338163 -0.507805 -2.811640 H 0.262533 0.284599 -2.811429 H 0.148769 -1.495484 -2.778498	
4-Methylpiperidine	C -1.215789 1.213797 0.190123 N -1.819048 -0.000009 -0.380548 C -1.215777 -1.213817 0.190114 C 0.278306 -1.260888 -0.169220 C 1.016008 0.000027 0.332033 C 0.278291 1.260912 -0.169234 H -2.828031 -0.000015 -0.186776 H -1.317952 -1.264355 1.304714 H -1.739974 -2.093915 -0.226315 H 0.739413 -2.171655 0.259671 H 0.375903 -1.327719 -1.270907 H 0.958467 0.000025 1.442815 C 2.498555 -0.000009 -0.071657	-291.012705

	H 0.739374 2.171693 0.259656 H 0.375870 1.327755 -1.270921 H -1.317929 1.264303 1.304729 H -1.740016 2.093894 -0.226267 H 3.021435 0.893688 0.316083 H 3.021649 -0.893146 0.317079 H 2.607558 -0.000616 -1.172673	

Table S9.- Full-optimized geometries and enthalpies at T = 298.15 K computed at the B3LYP/6-31G(d) level of theory for piperidine and the four methylpiperidine isomers.

Compound	Optimized Geometry / Å	Enthalpy / a.u.
Piperidine	C 0.743722 -1.220608 0.207537 N 1.379565 -0.010896 -0.319470 C 0.762938 1.209092 0.206788 C -0.706500 1.270446 -0.225818 C -1.459224 0.011089 0.231699 C -0.725662 -1.259202 -0.226584 H 2.371689 -0.018504 -0.092929 H 0.811818 1.265276 1.314070 H 1.312905 2.072604 -0.185733 H -1.177970 2.172828 0.183732 H -0.745413 1.345928 -1.320251 H -1.527615 0.011292 1.329932 H -2.489296 0.018935 -0.146322 H -1.211267 -2.154691 0.181649 H -0.764555 -1.333119 -1.321101 H 0.790367 -1.276256 1.314950 H 1.280739 -2.092925 -0.183443	-251.740980
1-Methylpiperidine	C 1.898500 -0.000028 0.240664 C 1.155267 -1.257752 -0.228441 C -0.317275 -1.209879 0.191661 N -0.970738 -0.000100 -0.307795 C -0.317439 1.209893 0.191431 C 1.155278 1.257832 -0.228218 H -0.852906 -2.078246 -0.211196 C -2.394893 -0.000049 -0.016967 H -0.853054 2.078168 -0.211904 H -0.386723 1.276643 1.299164	-291.024379

	H 1.206569 1.329251 -1.322514 H 1.622952 2.162234 0.180907 H 2.931695 0.000059 -0.128323 H 1.955133 -0.000133 1.339331 H 1.206251 -1.328851 -1.322778 H 1.623059 -2.162288 0.180280 H -0.386066 -1.276141 1.299389 H -2.863198 0.886699 -0.458992 H -2.863095 -0.887319 -0.458048 H -2.622071 0.000524 1.068463	
2-Methylpiperidine	C 1.235276 1.231370 0.206520 C 1.880570 -0.068746 -0.295108 C 1.082263 -1.282346 0.190560 N -0.311100 -1.162586 -0.244917 C -0.988993 0.010719 0.321906 C -0.257349 1.274737 -0.155763 H 1.497053 -2.206216 -0.229581 H -0.823012 -2.003304 0.017418 H -0.942281 0.000333 1.431868 C -2.458443 0.003598 -0.097163 H -0.371322 1.347188 -1.246140 H -0.733329 2.161326 0.283037 H 1.754978 2.105321 -0.205865 H 1.343556 1.289058 1.299868 H 1.895132 -0.074601 -1.392729 H 2.919923 -0.143676 0.049004 H 1.177188 -1.353537 1.293641 H -2.984795 0.874714 0.309004 H -2.543837 0.020792 -1.189384 H -2.971505 -0.895281 0.268566	-291.029851
3-Methylpiperidine	C -0.263380 -1.240617 0.139728	-291.027361

	N 1.132433 -1.204648 -0.301445 C 1.861691 -0.071794 0.271811 C 1.220806 1.236855 -0.200551 C -0.271955 1.270904 0.162094 C -1.007253 0.015173 -0.341353 H 1.593636 -2.074919 -0.045096 H 1.866878 -0.087584 1.381427 H 2.905774 -0.127868 -0.058265 H 1.744857 2.091529 0.245766 H 1.338277 1.311062 -1.289323 H -0.377407 1.327638 1.256949 H -0.745694 2.174674 -0.243579 C -2.477270 -0.000704 0.089627 H -0.960191 0.011536 -1.439962 H -0.359329 -1.304419 1.244367 H -0.735190 -2.139037 -0.277206 H -2.999392 -0.883297 -0.299703 H -2.570115 -0.013479 1.183366 H -3.004968 0.887802 -0.276765	
4-Methylpiperidine	C -1.212466 1.212791 0.186557 N -1.813026 -0.000004 -0.371570 C -1.212459 -1.212798 0.186557 C 0.277948 -1.258107 -0.167300 C 1.012532 0.000009 0.331247 C 0.277943 1.258114 -0.167302 H -2.815164 -0.000007 -0.193720 H -1.320168 -1.271362 1.289375 H -1.729933 -2.082597 -0.235321 H 0.734696 -2.159780 0.262073 H 0.378024 -1.328398 -1.259147 H 0.959037 0.000008 1.432417 C 2.490657 -0.000002 -0.072218	-291.027476

	H 0.734677 2.159795 0.262074 H 0.378020 1.328412 -1.259148 H -1.320167 1.271352 1.289376 H -1.729943 2.082590 -0.235317 H 3.008954 0.886318 0.313654 H 3.008969 -0.886252 0.313795 H 2.599249 -0.000090 -1.164365	

Table S10.- Full-optimized geometries computed with the G3MP2B3 approach, at B3LYP/6-31G(d) level of theory, for the dimethylpiperidine isomers and the 2,2,6,6-tetramethylpiperidine. Geometries for *cis*-dimethylcompounds are for the most stable diequatorial substituted piperidines.

Compound	**Optimized Geometry / Å**
cis-1,2-dimethylpiperidine	C -0.816196 0.159761 0.476919 C -0.653161 1.388801 -0.436456 C 0.804248 1.844904 -0.553877 C 1.684113 0.665330 -0.977277 C 1.464024 -0.522366 -0.040281 N 0.056504 -0.932395 0.003828 H -1.279637 2.202131 -0.048596 C -2.290576 -0.260039 0.518541 H 2.053248 -1.381803 -0.382272 C -0.080168 -2.155284 0.786223 H -0.514176 0.458123 1.505251 H -1.039376 1.129758 -1.432124 H 0.891927 2.675669 -1.265270 H 1.148585 2.224595 0.419425 H 1.429087 0.360746 -2.000749 H 2.745616 0.943629 -0.972806 H 1.838768 -0.263104 0.973499 H -2.916707 0.613438 0.731598 H -2.596552 -0.672946 -0.449907 H -2.497993 -1.005092 1.292325 H -1.088455 -2.566241 0.695325 H 0.617457 -2.906574 0.400906 H 0.138972 -2.012208 1.863851
trans-1,2-dimethylpiperidine	N -0.541420 -0.884300 -0.101829 C -0.381141 0.295520 -0.971910 C 1.118885 0.637234 -1.070660

	C 1.764210 0.835075 0.308686 C 1.498801 -0.388411 1.195066 C 0.002887 -0.716261 1.244608 H -0.713308 -0.024955 -1.969541 C -1.884377 -1.438145 -0.094900 H 1.250833 1.531841 -1.692440 H -0.152172 -1.658466 1.785248 C -1.234940 1.524104 -0.585811 H 1.623698 -0.191894 -1.582881 H 2.842778 1.004354 0.199437 H 1.357487 1.734781 0.791188 H 2.032835 -1.256616 0.786768 H 1.873604 -0.222671 2.213110 H -0.531080 0.064462 1.824368 H -2.230325 -1.576712 -1.125957 H -1.870109 -2.421547 0.390219 H -2.634162 -0.818712 0.433713 H -2.301412 1.276212 -0.557209 H -0.963031 1.933938 0.392763 H -1.101641 2.321394 -1.326465
cis-1,3-dimethylpiperidine	C -0.880860 -0.188083 0.515351 C -0.747861 1.036365 -0.402702 C 0.730824 1.443709 -0.512114 C 1.602072 0.246640 -0.913081 C 1.365319 -0.938864 0.026242 N -0.050321 -1.303338 0.062746 C -1.631150 2.191221 0.080743 H -1.924999 -0.526057 0.532348 H 1.934928 -1.811849 -0.315473 C -0.276013 -2.497423 0.861019 H -0.625203 0.110001 1.556417 H -1.088455 0.726417 -1.401362

	H 0.846706 2.264998 -1.231515 H 1.067737 1.829876 0.462553 H 1.357460 -0.061718 -1.937803 H 2.664894 0.519159 -0.899320 H 1.742330 -0.685989 1.041133 H -2.687169 1.897698 0.123122 H -1.336494 2.522555 1.084820 H -1.551302 3.054802 -0.589917 H -1.334186 -2.778907 0.816185 H 0.314162 -3.328634 0.458786 H -0.002143 -2.370371 1.928048
trans-1,3-dimethylpiperidine	N -0.942697 -0.655322 0.083882 C -0.741451 0.492637 -0.801360 C 0.748666 0.855777 -0.935264 C 1.331904 1.117016 0.469164 C 1.031660 -0.040413 1.432585 C -0.463689 -0.371865 1.436676 H 0.801744 1.794564 -1.504948 C -2.328768 -1.094019 0.086760 H -1.153533 0.239660 -1.786497 H -0.654375 -1.253640 2.060769 H -1.303036 1.379760 -0.436598 C 1.526327 -0.214657 -1.715927 H 2.412928 1.296382 0.406422 H 0.882820 2.037026 0.871157 H 1.593042 -0.935462 1.138293 H 1.351138 0.217975 2.450099 H -1.027309 0.471878 1.891943 H -2.637791 -1.353028 -0.932131 H -2.432988 -1.988103 0.711922 H -3.030199 -0.325983 0.471114 H 2.592216 0.037205 -1.774380

	H 1.429189 -1.198872 -1.248441 H 1.147142 -0.298961 -2.741703
cis-1,4-dimethylpiperidine	C 1.129702 0.602663 -0.674254 C -0.265743 0.575583 -1.304930 C -1.087049 -0.626551 -0.811078 C -1.082036 -0.637635 0.726271 C 0.341801 -0.568226 1.286251 N 1.049150 0.609219 0.785491 C -2.507641 -0.630501 -1.384379 H 1.668183 1.504328 -0.991337 H 0.312725 -0.509916 2.381363 C 2.360043 0.751251 1.397090 H 1.717326 -0.266734 -1.041577 H -0.790030 1.505099 -1.043358 H -0.172275 0.551846 -2.398766 H -0.576755 -1.541875 -1.152714 H -1.650208 0.226642 1.097061 H -1.580055 -1.540404 1.104126 H 0.884869 -1.503854 1.029955 H -2.494679 -0.647006 -2.481007 H -3.072765 -1.506207 -1.042611 H -3.059881 0.264957 -1.071438 H 2.834307 1.674926 1.046556 H 2.255768 0.814791 2.486153 H 3.044957 -0.090633 1.169330
trans-1,4-dimethylpiperidine	N 0.528297 1.178132 0.472469 C -0.806367 1.080934 -0.118239 C -1.534760 -0.173548 0.376542 C -0.736627 -1.466669 0.105778 C 0.702709 -1.278962 0.630825 C 1.347666 0.016823 0.126714

	H -1.202294 -2.275963 0.685656 C 1.184861 2.424296 0.112802 H -1.374267 1.973729 0.171746 H 2.332660 0.142353 0.593350 H -0.757353 1.085951 -1.227528 H -1.691290 -0.069912 1.457908 H -2.526427 -0.230065 -0.091359 C -0.778209 -1.890768 -1.371408 H 0.681114 -1.242165 1.727533 H 1.329074 -2.134792 0.346677 H 1.523463 -0.040694 -0.968180 H 0.572338 3.273023 0.437658 H 2.154778 2.491438 0.618600 H 1.361063 2.528707 -0.977127 H -0.231907 -2.829830 -1.522429 H -1.811967 -2.049065 -1.702106 H -0.332699 -1.142279 -2.035767
2,2-dimethylpiperidine	N 0.114362 -1.243257 -0.098320 C -0.774666 -0.167547 0.393528 C -0.613309 1.037047 -0.564075 C 0.849946 1.461269 -0.766266 C 1.706219 0.261415 -1.194104 C 1.533636 -0.894919 -0.205461 C -2.212534 -0.701215 0.305055 H 0.005272 -2.062322 0.498167 H -1.209622 1.879915 -0.191363 H 2.068317 -1.783096 -0.563269 C -0.483485 0.240611 1.857572 H -1.033828 0.750709 -1.537059 H 0.904185 2.260023 -1.516821 H 1.253764 1.885331 0.163644 H 1.391197 -0.078049 -2.189613

	H 2.764886 0.542444 -1.260548 H 1.996307 -0.613577 0.760207 H -2.937253 0.069610 0.592047 H -2.434033 -1.031692 -0.714764 H -2.355042 -1.557549 0.977625 H -0.597592 -0.624415 2.523475 H 0.530289 0.630681 1.991900 H -1.182225 1.014825 2.197110
cis-2,3-dimethylpiperidine	C -0.205335 1.033056 0.392776 C 1.335991 0.949186 0.461593 C 1.904295 -0.114692 -0.490351 C 1.218067 -1.462742 -0.251608 N -0.232420 -1.303206 -0.376628 C -0.789309 -0.384444 0.625578 C -2.316855 -0.437855 0.578573 H 1.552143 -2.200801 -0.990569 H -0.685534 -2.211020 -0.287595 H -0.474574 -0.683527 1.647939 C -0.695519 1.685245 -0.910148 H -0.542367 1.659211 1.232059 H 1.777235 1.931506 0.248464 H 1.628516 0.691484 1.490312 H 1.747619 0.184837 -1.533718 H 2.986855 -0.217294 -0.342642 H 1.515173 -1.842148 0.747997 H -2.754692 0.287034 1.274246 H -2.688039 -0.223635 -0.428376 H -2.679725 -1.433184 0.865695 H -1.766136 1.912882 -0.866571 H -0.168152 2.630042 -1.088814 H -0.529400 1.030525 -1.770510

trans-2,3-dimethylpiperidine	C -0.489652 0.789431 -0.352988 C 0.993813 1.196199 -0.458249 C 1.891913 0.018109 -0.855435 C 1.658304 -1.162773 0.088018 N 0.238790 -1.515051 0.075748 C -0.634428 -0.442561 0.572405 C -2.065516 -0.979923 0.645865 H 2.234808 -2.036897 -0.237566 H 0.089361 -2.350402 0.638955 H -0.330579 -0.119283 1.591718 H -0.826394 0.472541 -1.351471 C -1.342881 1.980607 0.101618 H 1.100741 2.020269 -1.175997 H 1.322816 1.589382 0.516511 H 1.657957 -0.298866 -1.879870 H 2.948471 0.314007 -0.834585 H 2.020528 -0.890055 1.100633 H -2.751557 -0.248787 1.083265 H -2.426540 -1.248818 -0.353327 H -2.107635 -1.880925 1.271502 H -2.415256 1.763402 0.062864 H -1.096602 2.274760 1.130450 H -1.160970 2.850485 -0.540729
cis-2,4-dimethylpiperidine	C -0.566175 0.500856 0.765088 C -1.220255 0.173382 -0.589393 C -0.500128 -1.022838 -1.235741 C 1.011781 -0.788805 -1.298316 N 1.525426 -0.526189 0.046970 C 0.954520 0.685823 0.646379 C 1.608847 0.943321 2.003600 H 1.518712 -1.676498 -1.695078 H 2.539907 -0.438422 0.013996

	H 1.131727 1.572239 0.000726 H -0.761557 -0.318575 1.471903 H -1.013164 1.410284 1.189168 C -2.727676 -0.067471 -0.452959 H -1.071915 1.044042 -1.248927 H -0.693148 -1.927757 -0.643302 H -0.891737 -1.202596 -2.245809 H 1.216186 0.044572 -2.001414 H 1.191823 1.840910 2.473878 H 1.448797 0.090706 2.672831 H 2.691188 1.094152 1.899981 H -3.232371 0.803319 -0.017176 H -3.188007 -0.269643 -1.427694 H -2.929913 -0.929023 0.196180
trans-2,4-dimethylpiperidine	N -0.155153 1.440103 -0.505594 C 0.411883 0.228448 -1.111771 C -0.386936 -0.985019 -0.608158 C -0.435572 -1.086013 0.932695 C -0.880751 0.271335 1.518680 C -0.062083 1.438216 0.956363 H 1.472716 0.092346 -0.817520 H -1.202813 -1.829569 1.191156 C 0.888479 -1.585282 1.535876 C 0.358442 0.345897 -2.635042 H -0.463730 2.388126 1.328941 H 0.327409 2.257113 -0.876753 H -1.411365 -0.890327 -0.993092 H 0.037407 -1.904349 -1.033776 H -1.934212 0.443907 1.263587 H -0.807415 0.257541 2.614150 H 0.983743 1.369404 1.315800 H 0.804246 -1.693021 2.624132

	H 1.158622 -2.565122 1.123394 H 1.723959 -0.905123 1.337374 H 0.941117 1.207153 -2.986917 H 0.771338 -0.551015 -3.110345 H -0.675712 0.476732 -2.972825
cis-2,5-dimethylpiperidine	C -0.256213 0.278712 -1.347618 C -1.073360 -0.913868 -0.822822 C -1.110121 -0.968894 0.719796 C 0.332895 -0.880455 1.249951 N 0.986031 0.329985 0.745687 C 1.142318 0.321773 -0.713697 C 1.937072 1.550515 -1.153953 H 0.332360 -0.841479 2.346218 H 1.900171 0.431490 1.183153 H 1.687837 -0.586325 -1.049437 H -0.768641 1.222753 -1.121737 H -0.161584 0.217777 -2.439667 H -2.093792 -0.884237 -1.226744 H -0.617654 -1.842917 -1.195782 C -2.012478 0.109968 1.336702 H -1.507605 -1.951220 1.012996 H 0.874544 -1.802411 0.955447 H 2.054220 1.569560 -2.243274 H 1.426254 2.468149 -0.841332 H 2.941468 1.554466 -0.710942 H -2.093714 -0.027157 2.422046 H -1.611573 1.112224 1.161025 H -3.025186 0.062918 0.918071
trans-2,5-dimethylpiperidine	C -0.851500 1.204975 -0.167561 C 0.588871 1.319114 0.354006 C 1.470191 0.165342 -0.155203

	C 0.780124 -1.171483 0.153764 N -0.562989 -1.198364 -0.428428 C -1.451638 -0.175534 0.136174 C -2.854238 -0.336029 -0.449118 H 1.357749 -2.000683 -0.273438 H -0.976627 -2.118253 -0.285225 H -1.520551 -0.272060 1.240826 H -0.864481 1.354391 -1.255875 H -1.482241 1.985546 0.277351 H 1.024344 2.284969 0.065435 H 0.579431 1.298374 1.455047 H 1.536124 0.244960 -1.250002 C 2.884868 0.219750 0.430488 H 0.769717 -1.315561 1.254619 H -3.534438 0.423526 -0.047649 H -2.825544 -0.239200 -1.540104 H -3.274995 -1.320621 -0.207309 H 3.512192 -0.589566 0.037456 H 3.375244 1.170037 0.188626 H 2.864928 0.125886 1.523945
cis-2,6-dimethylpiperidine	C -0.983020 1.358013 -0.263448 C 0.484835 1.788969 -0.389459 C 1.367550 0.603395 -0.803527 C 1.163298 -0.595081 0.134867 N -0.265017 -0.935958 0.154328 C -1.126544 0.140034 0.660976 C -2.569969 -0.356647 0.738513 C 1.972430 -1.814942 -0.305072 H -0.400652 -1.768508 0.727404 H -0.812037 0.457408 1.677767 H -1.376643 1.088811 -1.253270 H -1.595625 2.184207 0.120072

	H 0.583164 2.610860 -1.109740 H 0.832415 2.178500 0.578879 H 1.111992 0.289926 -1.825094 H 2.426352 0.893050 -0.804006 H 1.514181 -0.289308 1.143308 H -3.235347 0.432786 1.105747 H -2.917620 -0.675668 -0.250371 H -2.659666 -1.211662 1.421020 H 1.834424 -2.654263 0.388750 H 1.655838 -2.144157 -1.301007 H 3.042852 -1.582728 -0.336851
trans-2,6-dimethylpiperidine	C -0.775853 1.394076 0.126355 C 0.736565 1.634316 0.025073 C 1.376177 0.631182 -0.946451 C 1.025794 -0.826504 -0.592103 N -0.439986 -0.942232 -0.494287 C -1.084412 -0.064883 0.493659 C -2.587040 -0.347503 0.503297 H 1.321003 -1.454828 -1.443916 H -0.689345 -1.910570 -0.296791 H -0.701822 -0.237516 1.519660 H -1.248493 1.613965 -0.841190 H -1.225522 2.063347 0.871263 H 0.939478 2.660309 -0.306993 H 1.189971 1.537971 1.021667 H 1.004859 0.833528 -1.959248 H 2.466217 0.755035 -0.969669 C 1.797517 -1.344514 0.639112 H -3.101755 0.302778 1.219776 H -3.013324 -0.181051 -0.492242 H -2.793075 -1.386917 0.790108 H 1.531305 -2.388298 0.848327

	H 2.879662 -1.307396 0.463209 H 1.588244 -0.761754 1.542391
3,3-dimethylpiperidine	N 0.111865 -1.697580 0.415552 C -0.759324 -0.607493 0.858598 C -0.656283 0.606419 -0.094217 C 0.835853 1.018712 -0.176797 C 1.773972 -0.157106 -0.494931 C 1.525318 -1.321459 0.468639 C -1.476072 1.772724 0.481454 H -0.050115 -2.520118 0.992159 H -1.792565 -0.976630 0.879630 H 2.129425 -2.191135 0.184338 H -0.512732 -0.265913 1.885131 C -1.208342 0.234638 -1.483538 H 0.959931 1.819568 -0.918263 H 1.129815 1.445734 0.793965 H 1.614245 -0.506522 -1.521946 H 2.819972 0.167406 -0.424023 H 1.844308 -1.018585 1.487714 H -2.536927 1.506275 0.570420 H -1.117996 2.063219 1.477146 H -1.408930 2.654871 -0.167222 H -1.064895 1.057582 -2.195014 H -0.722530 -0.659964 -1.881503 H -2.284786 0.028674 -1.426648
cis-3,4-dimethylpiperidine	N -0.204146 -1.762553 0.635445 C -1.066881 -0.672842 1.095555 C -0.975523 0.522337 0.127254 C 0.507323 0.981395 0.045946 C 1.435750 -0.201738 -0.291093 C 1.207625 -1.379809 0.662140

	H -1.548261 1.348539 0.574925 C 0.732698 2.170106 -0.895689 H -2.098401 -1.042843 1.141954 H 1.810633 -2.242467 0.354567 H -0.351407 -2.586530 1.213893 H -0.796728 -0.325366 2.114037 C -1.617128 0.187687 -1.228605 H 0.774285 1.314556 1.062206 H 1.259345 -0.536293 -1.321367 H 2.483970 0.120920 -0.234079 H 1.546885 -1.088143 1.677835 H 1.759576 2.545328 -0.807837 H 0.573765 1.893663 -1.944308 H 0.053134 2.999143 -0.661714 H -1.582376 1.038505 -1.917190 H -1.126239 -0.666152 -1.704078 H -2.672346 -0.077809 -1.090011
trans-3,4-dimethylpiperidine	C -1.040116 -0.864871 0.839599 C -0.911479 0.360239 -0.081704 C 0.575372 0.781979 -0.197608 C 1.446589 -0.434908 -0.567610 C 1.210833 -1.616812 0.374908 N -0.208843 -1.967123 0.358885 C -1.824253 1.490600 0.412089 H -2.083852 -1.201942 0.859009 H 1.790622 -2.487712 0.046697 H -0.367924 -2.791432 0.934480 H -0.780372 -0.554850 1.874036 H -1.247807 0.045339 -1.081017 C 0.802923 1.929364 -1.190909 H 0.893016 1.126214 0.801265 H 1.211078 -0.751259 -1.592993

	H 2.507322 -0.151350 -0.550145 H 1.570837 -1.346414 1.389127 H -2.855832 1.136203 0.528330 H -1.492749 1.870662 1.387349 H -1.846074 2.334620 -0.284197 H 1.870764 2.166603 -1.271429 H 0.448883 1.655288 -2.193308 H 0.284771 2.846343 -0.891994
cis-3,5-dimethylpiperidine	N -1.341378 -1.157036 -0.312810 C -1.175783 0.016189 -1.171648 C 0.309701 0.394477 -1.267631 C 0.875219 0.615843 0.147023 C 0.593867 -0.571284 1.086037 C -0.906266 -0.899637 1.060521 C 0.524142 1.616145 -2.166949 H 1.956034 0.807599 0.095187 H -1.567610 -0.224989 -2.167588 H -1.105487 -1.795866 1.661087 H -2.316698 -1.447569 -0.314193 H -1.740640 0.898347 -0.802837 H 0.829600 -0.466761 -1.711219 H 0.419273 1.523879 0.574701 H 1.119358 -1.451565 0.688852 C 1.088873 -0.303300 2.510888 H -1.458605 -0.060004 1.532963 H 0.145757 1.438092 -3.180990 H 0.007238 2.498536 -1.767966 H 1.588994 1.864835 -2.246915 H 0.912159 -1.165909 3.164949 H 2.164587 -0.091381 2.521232 H 0.577167 0.561405 2.952964

trans-3,5-dimethylpiperidine	C -1.201163 -0.969782 -0.833398 N -1.190597 -1.004187 0.630323 C 0.171700 -1.016927 1.164525 C 0.900575 0.280885 0.783004 C 0.856597 0.463702 -0.746533 C -0.566821 0.340610 -1.334450 C 2.337871 0.296203 1.313328 H -0.471835 0.262221 -2.427018 H 1.297323 1.431467 -1.022517 H 0.117535 -1.111272 2.256230 H -2.241148 -1.042784 -1.174557 H -1.697747 -1.822691 0.958835 H 0.765690 -1.878350 0.791086 H 0.349805 1.108038 1.251002 H 1.493475 -0.309634 -1.203560 C -1.451586 1.557426 -1.023744 H -0.649244 -1.823558 -1.277414 H 2.362826 0.190839 2.404947 H 2.928462 -0.524203 0.885170 H 2.842297 1.235380 1.057053 H -2.408925 1.485670 -1.554457 H -1.672331 1.626850 0.045323 H -0.965041 2.488641 -1.338771
4,4-dimethylpiperidine	N 1.322847 1.043910 1.174212 C 1.489842 1.023635 -0.280192 C 0.116064 0.904859 -0.950265 C -0.688493 -0.334108 -0.480425 C -0.680993 -0.357052 1.069584 C 0.720230 -0.194847 1.670102 C -2.139265 -0.216586 -0.979514 H 2.225158 1.190469 1.621836 H 1.969145 1.961092 -0.586848

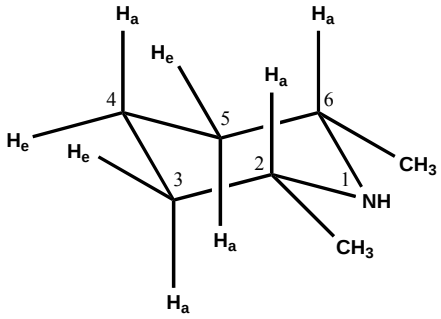
	H 0.647475 -0.131492 2.762483 H 2.147690 0.200747 -0.623047 H -0.455655 1.809675 -0.705622 H 0.235728 0.881330 -2.042046 C -0.081951 -1.632363 -1.052141 H -1.301210 0.470966 1.437177 H -1.135282 -1.289233 1.432241 H 1.332976 -1.089129 1.441497 H -2.178540 -0.182875 -2.075751 H -2.741003 -1.073367 -0.650493 H -2.617467 0.694319 -0.599099 H -0.659813 -2.505718 -0.724716 H -0.097468 -1.615717 -2.149142 H 0.955738 -1.789656 -0.740847
2,2,6,6-tetramethylpiperidine	C -1.201848 -0.502654 -0.209604 C -1.173583 -0.394549 1.330699 C 0.249768 -0.384026 1.901518 C 1.065879 0.749049 1.267502 C 1.101059 0.673287 -0.274586 N -0.287756 0.521754 -0.755914 C 1.600829 2.017009 -0.837774 C -2.607391 -0.131797 -0.718993 H -0.293024 0.475819 -1.773767 C -0.900852 -1.953595 -0.665041 H -1.671889 0.540953 1.618538 H -1.759564 -1.216387 1.761506 H 0.212756 -0.251372 2.990241 H 0.739130 -1.351796 1.730227 H 0.613057 1.707790 1.554020 H 2.093462 0.751219 1.652799 C 2.079068 -0.431971 -0.749072 H -3.368880 -0.797248 -0.295277

	H -2.848801 0.900772 -0.449212 H -2.663180 -0.218648 -1.812306 H 1.654435 1.986374 -1.934215 H 0.918578 2.824431 -0.555178 H 2.604435 2.252543 -0.464243 H -0.809585 -2.001283 -1.757419 H 0.022527 -2.351641 -0.237069 H -1.716202 -2.626410 -0.371226 H 2.015597 -0.558633 -1.837107 H 3.114133 -0.160037 -0.507211 H 1.879736 -1.403241 -0.289593

Table S11.- G3MP2B3 enthalpies at $T = 298.15$ K for piperidine, for the four methylpiperidine isomers, for the twelve dimethylpiperidines and for 2,2,6,6-tetramethylpiperidine. *Cis*-dimethylcompounds are diequatorial substituted piperidines; equatorial 2-position in dimethylpiperidines is most stable than any other position, as suggested by the more negative enthalpy of 2-methylpiperidine.

Compound	**Enthalpy / a .u.**
Piperidine	-251.439266
1-Methylpiperidine	-290.670673
2-Methylpiperidine	-290.680851
3-Methylpiperidine	-290.678271
4-Methylpiperidine	-290.678403
Cis-1,2-dimethylpiperidine	-329.905577
Trans-1,2-dimethylpiperidine	-329.909030
Cis-1,3-dimethylpiperidine	-329.909611
Trans-1,3-dimethylpiperidine	-329.907641
Cis-1,4-dimethylpiperidine	-329.906732
Trans-1,4-dimethylpiperidine	-329.909769
2,2-Dimethylpiperidine	-329.919068
Cis-2,3-dimethylpiperidine	-329.916523
Trans-2,3-dimethylpiperidine	-329.918587
Cis-2,4-dimethylpiperidine	-329.919914
Trans-2,4-dimethylpiperidine	-329.916694
Cis-2,5-dimethylpiperidine	-329.917735
Trans-2,5-dimethylpiperidine	-329.919779
Cis-2,6-dimethylpiperidine	-329.922342
Trans-2,6-dimethylpiperidine	-329.917728
3,3-Dimethylpiperidine	-329.917506
Cis-3,4-dimethylpiperidine	-329.913989
Trans-3,4-dimethylpiperidine	-329.916020
Cis-3,5-dimethylpiperidine	-329.917111
Trans-3,5-dimethylpiperidine	-329.915085
4,4-Dimethylpiperidine	-329.916495
2,2,6,6-Tetramethylpiperidine	-408.395631

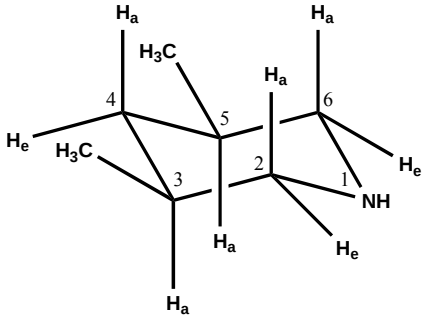
NMR Results



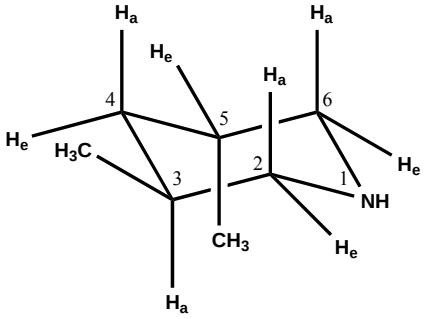
***cis*-2,6-dimethylpiperidine**

δ_H ($CDCl_3$, 300MHz)/ppm 2.52 (dtt, 2H, $^3J_{aa}$=13.2 Hz, ^3J=6.3 Hz; $^3J_{ae}$=2.4 Hz: *H-2 + H-6*); 1.62 (dq_i, 1H, ^2J=13.2 Hz, $^3J_{ee}$=3.3 Hz: *H-4$_e$*); 1.45 (ddt, 2H, ^2J=13.2 Hz, $^3J_{ee}$=3.3 Hz, $^3J_{ae}$=2.4 Hz: *H-3$_e$ + H-5$_e$*); 1.22 (tq, 1H, ^2J=$^3J_{aa}$=13.2 Hz, $^3J_{ae}$=3.9 Hz: *H-4$_a$*); 0.93 (d, 6H, ^3J=6.3 Hz: *CH$_3$*); 0.87 (dq, 2H, ^2J=$^3J_{aa1}$=$^3J_{aa2}$=13.2, $^3J_{ae}$=3.9 Hz: *H-3$_a$ + H-5$_a$*). ***Note***: no signal was observed at 1.55 ppm (H_2O).

δ_C ($CDCl_3$, 75.4MHz)/ppm 52.21 (*C-2 + C-6*); 33.83 (*C-3 + C-5*); 24.68 (*C-4*); 22.85 (*CH$_3$*).



***cis*-3,5-dimethylpiperidine**



***trans*-3,5-dimethylpiperidine**

δ_H ($CDCl_3$, 300MHz)/ppm 2.88 (dd, 2H, ^2J=12.3 Hz, $^3J_{ae}$=1.5 Hz: *H-2$_e$ + H-6$_e$ cis*); 2.76 (dd, 0.8H, ^2J=12.3 Hz, ^3J=3.9 Hz: *H-2$_e$ + H-6$_a$ trans*); 2.34 (dd, 0.8H, ^2J=12.3 Hz, ^3J=6.3 Hz: *H-2$_a$ + H-6$_e$ trans*); 2.00 (t, 2H, ^2J=$^3J_{aa}$=12.0 Hz: *H-2$_a$ + H-6$_a$ cis*); 1.67 (m, 1.8H: *H-4$_e$ cis and H-3 + H-5 trans*); 1.44 (m, 2H: *H-3 + H-5 cis*); 0.84 (d, 2.4H, ^3J=6.9 Hz: *CH$_3$ trans*); 0.74 (d, 6H, ^3J=6.6 Hz: *CH$_3$ cis*), 0.57 (q, 1H, ^2J=$^3J_{aa}$=12.2: *H-4$_a$ cis*). ***Note***: the H_2O singlet was observed at 1.55 ppm.

δ_C ($CDCl_3$, 75.4MHz)/ppm 54.12 (*C-2 + C-6 cis*); 53.31 (*C-2 + C-6 trans*); 42.68 (*C-4 cis*); 39.33 (*C-4 trans*); 32.48 (*C-3 + C-5 cis*); 27.29 (*C-3 + C-5 trans*); 19.48 (*CH$_3$ cis*); 18.45 (*CH$_3$ trans*).

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