Supporting Information

A Theoretical Study on Radical Scavenging Activity of Phenolic Derivatives Naturally Found within *Alternaria alternata* Extract.

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Table S1. The bond parameters of the optimized geometries of A, AB, AL and DA

Altenusin		Altenusin B		Alterlactone		Dehydroaltenusin	
Bond	**Bond length (Å)**	**Bond**	**Bond length (Å)**	**Bond**	**Bond length (Å)**	**Bond**	**Bond length (Å)**
1C-2C	1.428	1C-2C	1.385	1C-2C	1.432	1C-2C	1.414
1C-6C	1.382	1C-6C	1.396	1C-6C	1.422	1C-6C	1.401
1C-9C	1.501	2C-3C	1.400	1C-16C	1.482	2C-3C	1.416
2C-3C	1.426	3C-4C	1.386	2C-3C	1.390	2C-9C	1.462
2C-27C	1.464	4C-9C	1.501	3C-4C	1.390	3C-4C	1.384
3C-4C	1.400	4C-5C	1.426	4C-5C	1.400	3C-12C	1.469
4C-5C	1.386	5C-6C	1.423	5C-6C	1.398	4C-5C	1.407
5C-6C	1.408	5C-25C	1.479	6C-17C	1.488	5C-6C	1.392
9C-11C	1.398	9C-10C	1.399	17C-18C	1.401	12C-13C	1.517
9C-10C	1.403	9C-11C	1.403	17C-27C	1.403	12C-20C	1.347
10C-23C	1.510	10C-12C	1.387	18C-19C	1.493	13C-14C	1.547
10C-12C	1.399	11C-14C	1.397	18C-24C	1.396	13C-18C	1.498
11C-13C	1.388	11C-32C	1.509	24C-25C	1.386	18C-22C	1.339
12C-15C	1.387	12C-15C	1.398	27C-28C	1.387	20C-23C	1.461
13C-15C	1.399	14C-15C	1.389	2C-14O	1.340	23C-22C	1.461
3C-21O	1.338	2C-23O	1.358	4C-9O	1.356	1C-24O	1.335
5C-29O	1.353	6C-21O	1.348	10C-9O	1.424	5C-29O	1.352
13C-17O	1.364	12C-19O	1.380	16C-23O	1.223	9C-10O	1.223
15C-19O	1.379	15C-17O	1.364	16C-22O	1.347	9C-11O	1.348
27C-28O	1.232	25C-26O	1.204	19C-22O	1.445	13C-11O	1.469
27C-34O	1.343	25C-27O	1.384	25C-32O	1.374	23C-26O	1.226
30C-29O	1.425	28C-27O	1.441	28C-30O	1.359	22C-27O	1.346
4C-7H	1.080	1C-7H	1.084	3C-7H	1.082	30C-29O	1.426
6C-8H	1.082	3C-8H	1.082	5C-8H	1.079	6C-8H	1.080
11C-14H	1.083	10C-13H	1.086	10C-11H	1.088	4C-7H	1.081
12C-16H	1.087	14C-16H	1.084	10C-12H	1.095	14C-15H	1.091
23C-25H	1.095	28C-29H	1.088	10C-13H	1.095	14C-16H	1.092
23C-24H	1.093	28C-31H	1.090	19C-20H	1.089	14C-17H	1.091
23C-26H	1.092	28C-30H	1.090	19C-21H	1.089	18C-19H	1.084
30C-31H	1.095	32C-33H	1.093	24C-26H	1.086	20C-21H	1.084
30C-32H	1.095	32C-34H	1.095	27C-29H	1.082	30C-31H	1.094
30C-33H	1.088	32C-35H	1.092	14O-15H	0.985	30C-32H	1.088
17O-18H	0.966	17O-18H	0.966	30O-31H	0.966	30C-33H	1.094
19O-20H	0.962	19O-20H	0.962	32O-33H	0.962	24O-25H	0.988
21O-22H	0.988	21O-22H	0.973			27O-28H	0.975
34O-35H	0.969	23O-24H	0.963				

Table S2. Global chemical reactivity descriptors (eV) of the studied compounds and comparison with gallic acid (GA).

S. No	Parameters	Altenusin	Altenusin B	Alterlactone	Dehydroaltenusin	GA
1	Electronegativity(χ)	3.469	3.342	3.783	4.783	4.19
2	Chemical potential (μ)	-3.469	-3.342	-3.783	-4.783	-4.19
3	Chemical hardness (η)	2.155	2.107	2.250	1.860	3.64
4	Chemical softness(S)	1.078	1.054	1.125	0.930	0.14
5	Electrophilicity (ω)	12.967	11.767	16.097	21.268	2.41

Table S3: The bond length of the selected OH sites.

Sl.no	Antioxidants	Position of OH	Bond length
1	A	A-1	0.988
		A-2	0.962
		A-3	0.966
2	AB	AB-1	0.973
		AB-2	0.963
		AB-3	0.966
		AB-4	0.962
3	AL	AL-1	0.985
		AL-2	0.966
		AL-3	0.962
4	DA	DA-1	0.988
		DA-2	0.975

Table S4. Computed topological values of hydrogen bond interactions in altenusin, altenusin B, alterlactone and dehydroaltenusin using AIMAll. All the values are in a.u

Hydrogen interaction	OH bond	ρ	$\nabla^2\rho$	Ellipticity	Energy (kcal/mol)
21O-22H---28O	A-1	0.054	0.155	0.004	-17.740
21O-22H---27O	AB-2	0.045	0.156	0.059	-12.041
14O-15H---23O	AL-1	0.050	0.150	0.014	-14.274
24O-25H--10O	DA-1	0.047	0.139	0.003	-12.775
27O-28H---26O	DA-2	0.026	0.101	0.739	-7.349

Table S5: The calculated value of ΔE_{iso} to find out the stability of the radicals.

Sl.no	Antioxidants	Position of OH	ΔE_{iso} (kcal/mol)
1	A	A-1	8.75
		A-2	-12.47
		A-3	-3.40
2	AB	AB-1	3.85
		AB-2	3.04
		AB-3	-3.71
		AB-4	-13.49
3	AL	AL-1	10.79
		AL-2	-0.41
		AL-3	-10.71
4	DA	DA-1	15.83
		DA-2	7.43

Table S6: Calculated value of BDE, the proton dissociation enthalpy (PDE), ETEs, PAs, SET-PT and SPLET mechanism enthalpies for the different OH positions in Altenusun B, Altenusin, Dehydroaltenusin and Alterlactone using M062x function.

Sl.no	Compound	Position of OH	BDE (kcal/mol)	PDE (kcal/mol)	ETE (kcal/mol)	PA (kcal/mol)	IE + PDE (kcal/mol)	PA + ETE (kcal/mol)
1	A	A 1	102.89	416.51	105.5	312.18	548.60	417.68
		A 2	83.19	396.81	93.3	304.58	528.90	397.93
		A 3	87.99	401.60	88.6	314.07	533.70	402.71
2	AB	AB 1	99.70	413.32	105.6	308.88	543.77	414.49
		AB 2	99.31	412.93	111.3	302.82	543.38	414.12
		AB 3	87.85	401.46	90.1	312.43	531.92	402.57
		AB 4	82.14	395.76	90.7	306.12	526.21	396.87
3	AL	AL 1	102.46	416.08	107.4	309.82	556.10	417.26
		AL 2	91.86	405.48	97.5	309.10	545.49	406.62
		AL 3	85.93	399.54	101.0	299.69	539.56	400.70
4	DA	DA 1	106.58	420.20	114.3	307.11	572.25	421.40
		DA 2	97.69	411.31	111.4	301.12	563.36	412.50

Table S7. Gibbs free energies of reactants (R), transition states (TSs) and products (P) of the different OH site for the radical (•OOH) attacks with the dibenzopyrone phenolic derivatives calculated at UB3LYP/6-311G(d,p) and M06-2X/cc-pVDZ level of theory in the gas and water phase.

Antioxidants	UB3LYP/6-311G(d,p)						M06-2X/cc-pVDZ		
	Gas Phase			Water Phase			Water Phase		
	R	TS	P	R	TS	P	R	TS	P
A-1	0	23.89	11.17	0	23.07	6.07	0	31.08	12.41
A-2	0	6.40	-8.71	0	9.51	-8.40	0	12.55	-5.60
A-3	0	12.74	-0.12	0	12.45	-4.11	0	20.50	-1.22
AB-1	0	19.30	6.67	0	20.11	3.81	0	20.59	9.08
AB-2	0	14.44	5.79	0	16.77	4.70	0	23.82	8.93
AB-3	0	12.41	-0.01	0	12.34	-4.18	0	13.05	-1.23
AB-4	0	5.91	-9.52	0	8.71	-9.49	0	12.08	-6.62
AL-1	0	22.09	12.84	0	20.57	7.51	0	24.57	12.04
AL-2	0	13.55	2.24	0	14.52	-1.08	0	19.55	2.53
AL-3	0	6.54	-7.70	0	10.27	-6.85	0	18.60	-2.96
DA-1	0	25.05	17.32	0	24.80	11.82	0	28.83	16.35
DA-2	0	19.09	9.24	0	19.17	5.46	0	27.56	7.31

Table S8. The docking scores of compounds A, AB, AL and DA with XO enzyme.

S.No.	Antioxidants	Docking Score (kcal/mol)
1	A	-52.08
2	AB	-58.98
3	AL	-42.57
4	DA	-42.57

171 **Table S9.** QikProp predicted ADMET properties.

Antioxidants	MW	No. of Rotatable Bonds	Donor HB	Accept HB	QP log o/w	No. of Primary Metabolites	QP log BB for brain/blood	Rule of Five
A	290.272	6	3	4	1.904	5	-1.716	0
AB	290.272	6	3	4	1.41	5	-1.894	0
AL	288.256	4	2	5	1.157	5	-1.322	0
DA	288.256	3	1	6.25	0.72	3	-1.377	0
Range	130 to 725	0 to 15	0 to 6	2 to 20	-2 to 6.5	1 to 8	-3 to 1.2	Maximum 4

MW- Molecular weight of the molecule
Donor HB - Estimated number of hydrogen bonds that would be donated by the solute to water molecules in an aqueous solution
Accept HB - Estimated number of hydrogen bonds that would be accepted by the solute from water molecules in an aqueous solution
QP log o/w - Predicted octanol/water partition coefficient
Rule of Five- Lipinski's Rule of 5 Violations

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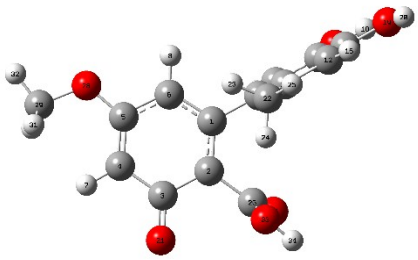
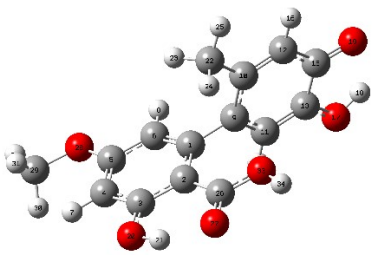
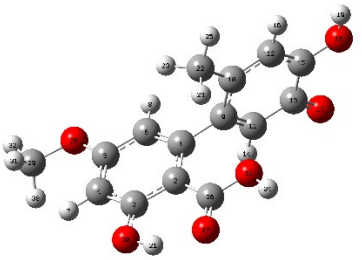
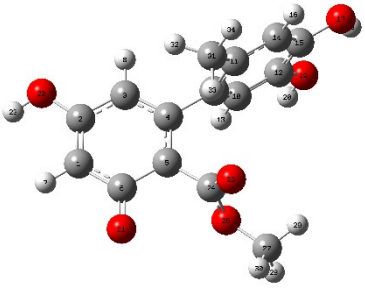
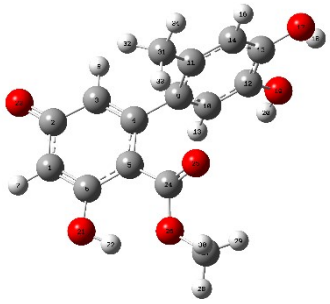
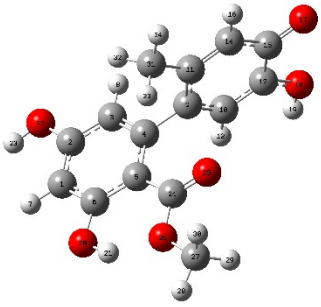
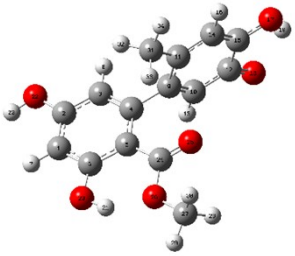
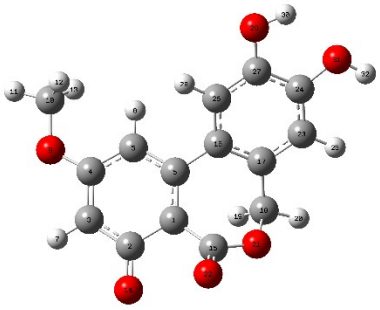
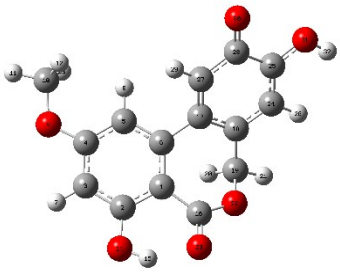
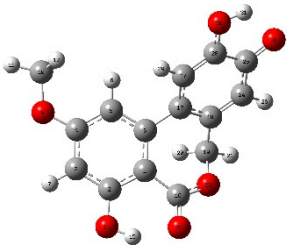
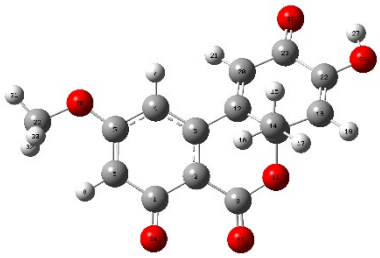
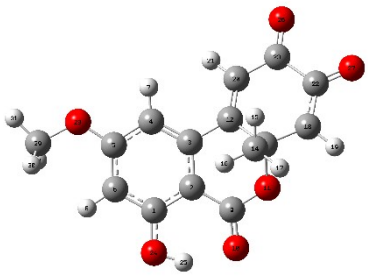
176 **Table S10**: The optimized structure of the radicals of A, AB, AL and DA

A-1	
A-2	

A-3	
AB-1	
AB-2	
AB-3	
AB-4	

AL-1	
AL-2	
AL-3	
DA-1	
DA-2	

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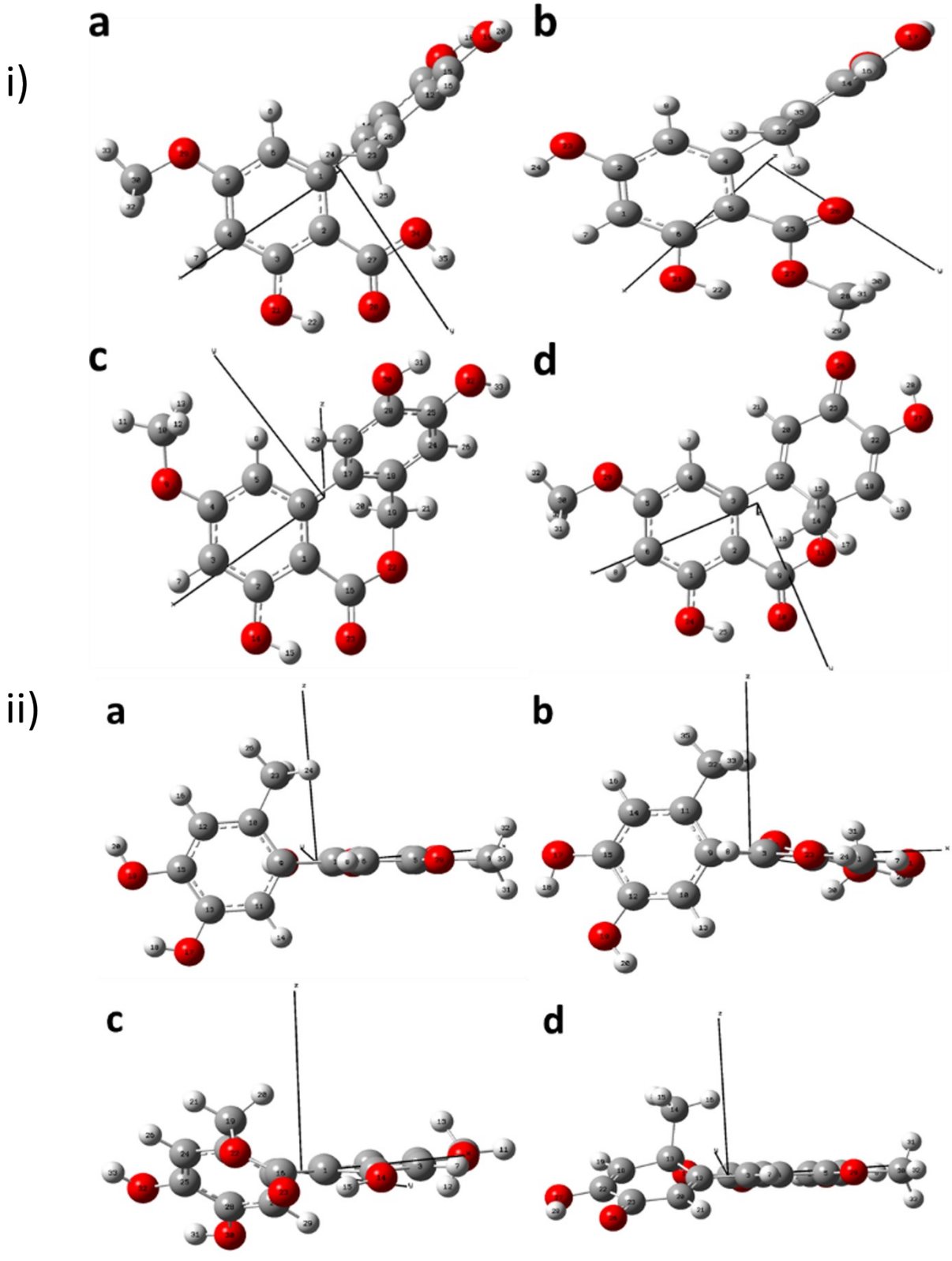

Figure S1: i) The side view ii) The top view of the optimized structures of a) A b) AB c) AL and d) DA.

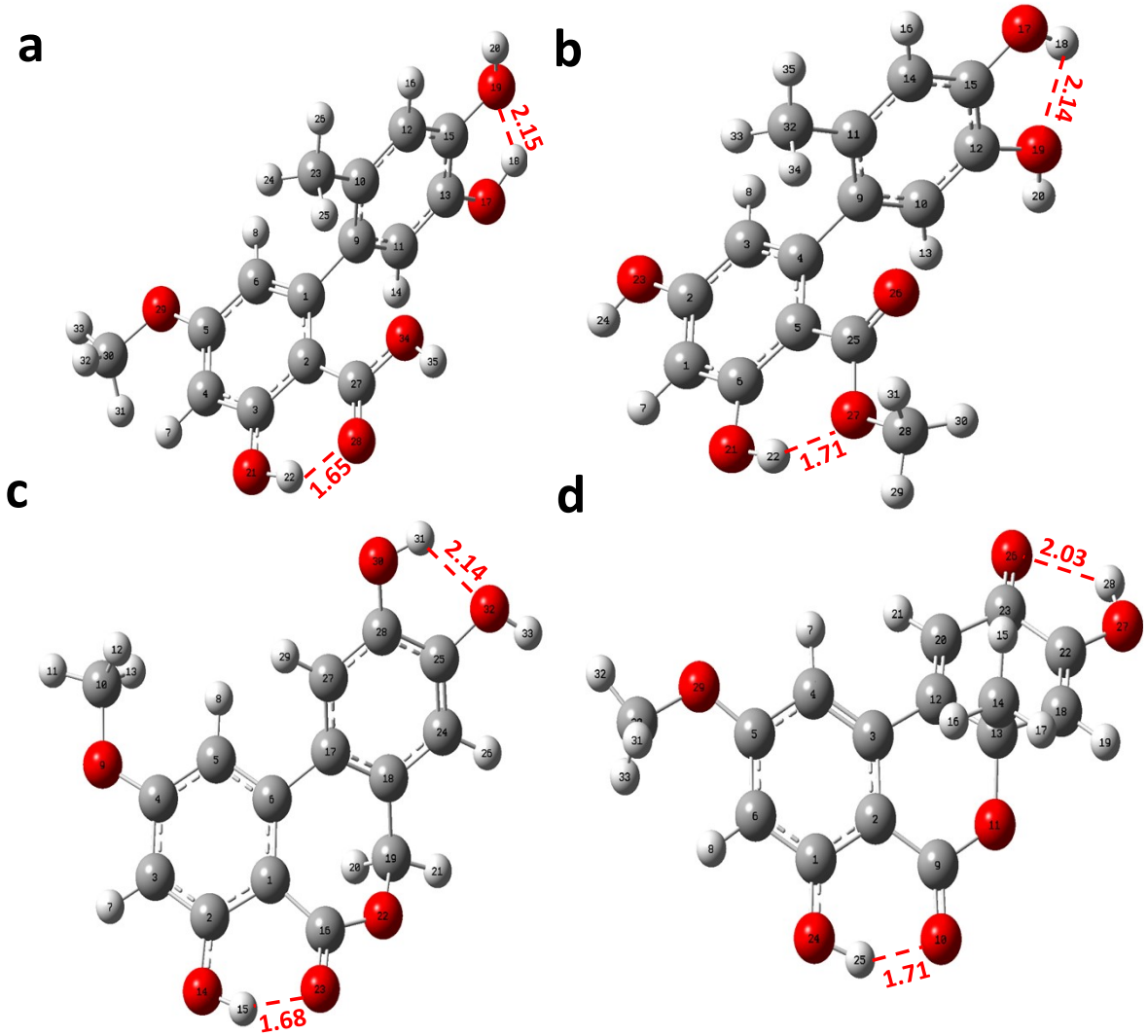

Figure. S2: The expected hydrogen bonding in the compounds with the distance in Å.

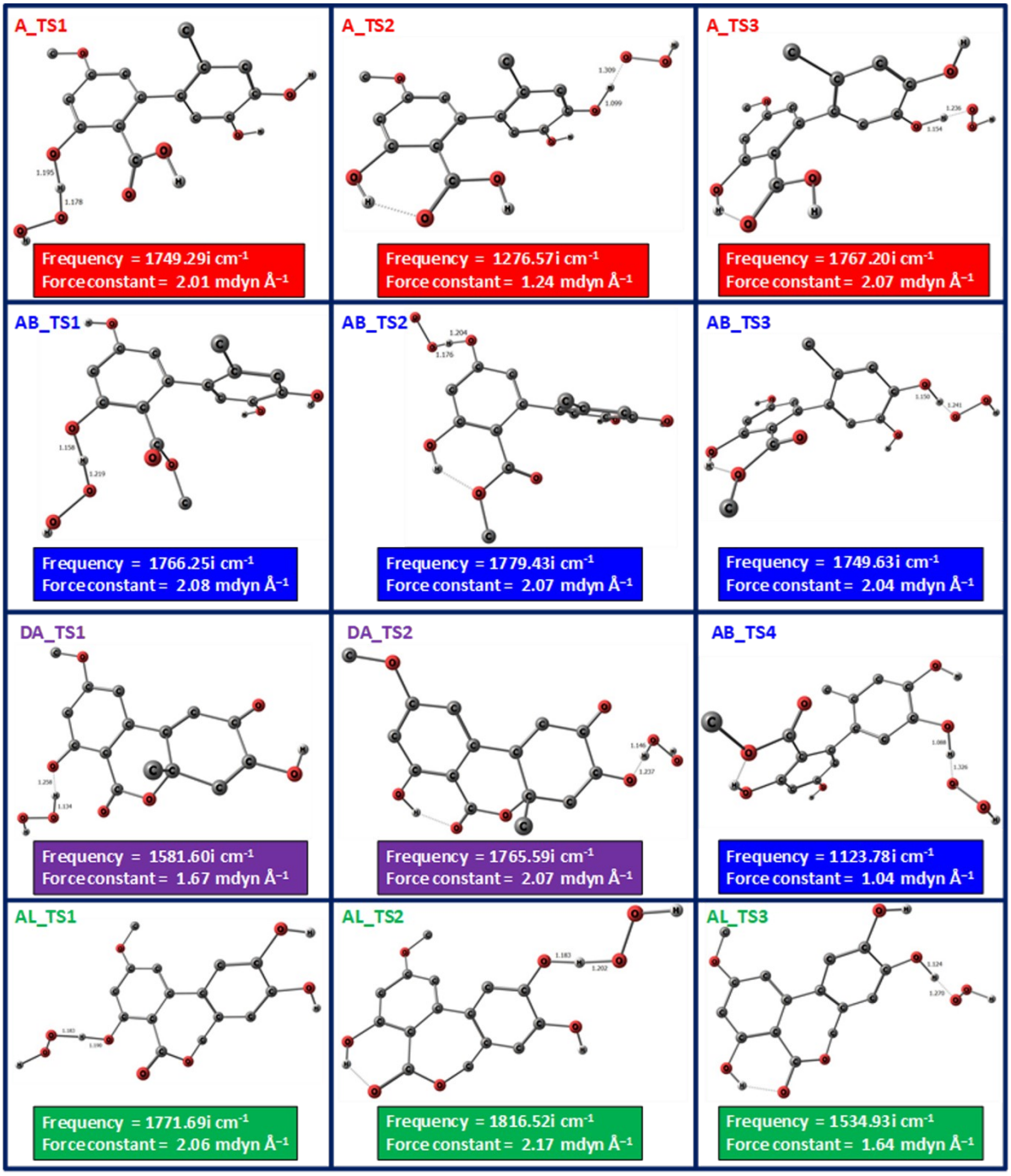

Figure S3 Optimized geometries for Transition state structures of A, AB, AL and DA with the selected pertinent bond lengths and their imaginary frequencies (cm^{-1}) at B3LYP/6-311G(d,p) level of theory in gas phase. Only relevant hydrogens are shown.

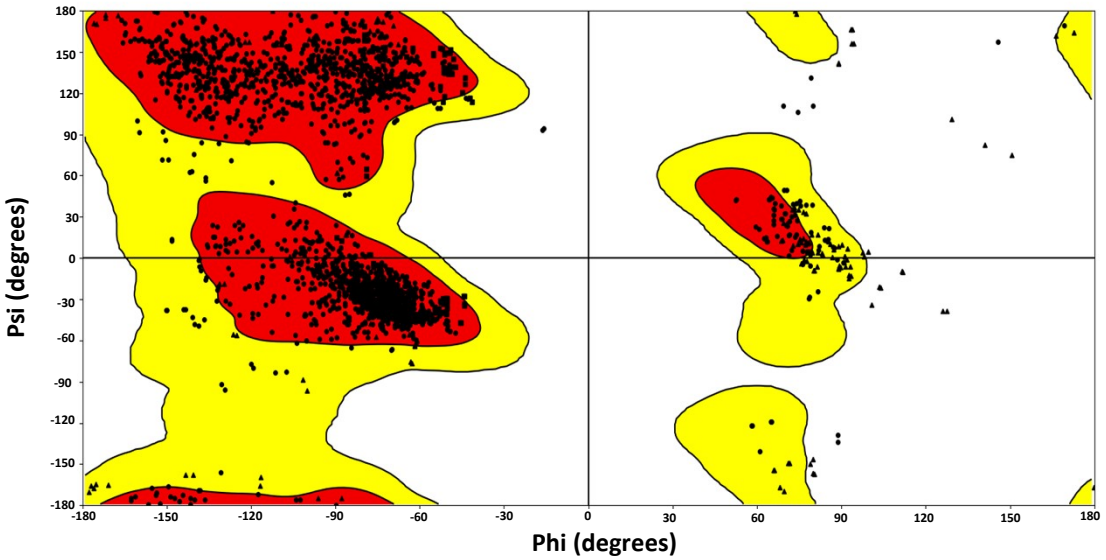

Figure S4: Ramachandra plot

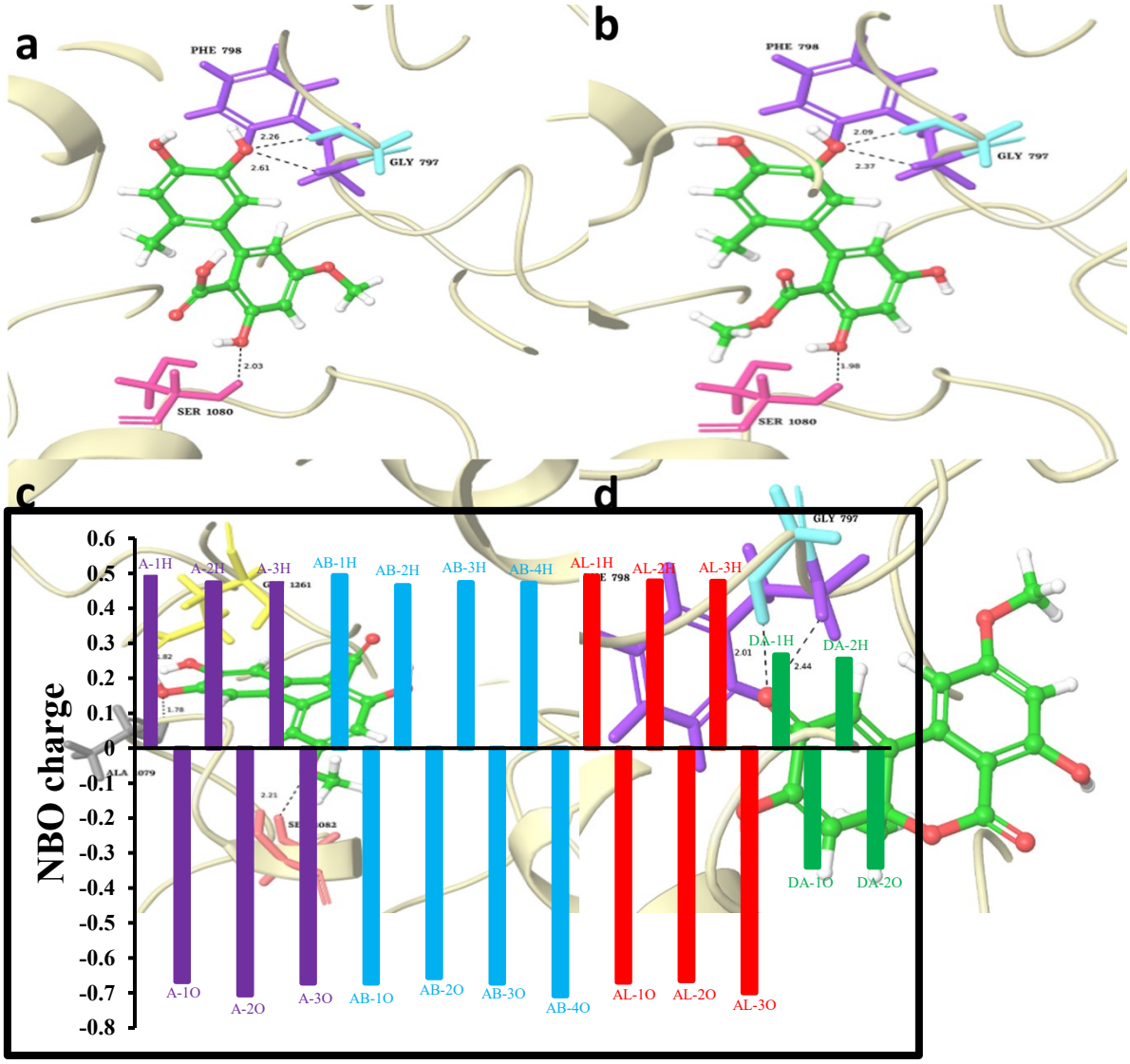

Figure S5: 3D interaction of the compounds a) A b) AB c) AL d) DA with XO enzyme

3.3 Atomic charges

The natural charge distribution analysis is used to reveal the most reactive atoms of a compound. It is reported that hydrogen of OH with the highest positive charge connected to oxygen with highest electronegative atom, will be cleaved easily to donate hydrogen. Hence, charges of different oxygen and hydrogen atoms of the four compounds were calculated and are represented graphically in figure 3. From the figure, it is clear that the oxygen of AB-4, A-2, and AL-3 are having the greatest negative charge, -0.708, -0.706, and -0.700 respectively.

Figure S6: Computed natural charge distribution for oxygen and hydrogen atoms in A, AB, AL, and DA.

Among all the OHs, the hydrogen of AB-1 is showing the greatest positive value + 0.494. The order of the hydrogen charge follows AB-1 > A-1 > AL-1 > AL-2 > AL-3 > A-3 > AB-3 > A-2 > AB-4 > AB-2 > DA-1 > DA-2.

This guides us to measure the tendency of the OH that is more favourable for the bond cleavage. The AB-1, and A-1OHs are preferred to cleave more easily than the other OHs groups present in other compounds. This suggests that AB and A have better radical abstracting ability than the other molecules.

Table S11: Calculated value of BDE, the proton dissociation enthalpy (PDE), ETEs, PAs, SET-PT and SPLET mechanism enthalpies for the different OH positions in Altenusun B, Altenusin, Dehydroaltenusin and Alterlactone using B3LYP function.

Sl.no	Antioxidants	Position of OH	BDE (kcal/mol)	PDE (kcal/mol)	ETE (kcal/mol)	PA (kcal/mol)	IE + PDE (kcal/mol)	PA + ETE (kcal/mol)
1	A	A-1	99.94	417.87	61.4	357.25	588.73	418.62
		A-2	78.64	396.56	54.7	342.66	567.42	397.32
		A-3	87.74	405.67	47.3	359.12	576.52	406.42
2	AB	AB-1	95.03	412.95	63.8	349.93	578.22	413.71
		AB-2	94.21	412.14	72.6	340.34	577.40	412.89
		AB-3	87.43	405.36	48.0	358.12	570.62	406.11
		AB-4	77.62	395.54	48.7	347.55	560.80	396.30
3	AL	AL-1	101.99	419.92	64.5	356.17	597.61	420.67
		AL-2	90.75	408.68	62.8	346.62	586.37	409.43
		AL-3	80.41	398.34	68.4	330.64	576.03	399.09
4	DA	DA-1	107.06	424.98	79.0	346.76	617.03	425.74
		DA-2	98.62	416.54	66.9	350.41	608.59	417.30

XYZ Coordinate of the optimized structure of the four Antioxidants.

Altenusin

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C	0.50697200	-0.15854100	-0.00574400
C	1.24051500	1.05708800	-0.16224500
C	2.66274400	0.97754200	-0.22354200
C	3.32667800	-0.25064300	-0.14530900
C	2.59010100	-1.41851200	-0.00673500
C	1.18470700	-1.36174600	0.06451700
H	4.40560200	-0.24287400	-0.20006200
H	0.64001700	-2.28921500	0.18429000
C	-0.98822600	-0.24106900	0.09414100
C	-1.65244500	-0.05055700	1.31660300
C	-1.71359600	-0.59484400	-1.04883200
C	-3.04316200	-0.21113200	1.34979100
C	-3.09302400	-0.74543400	-1.00465300
H	-1.20699700	-0.75072900	-1.99416800
C	-3.76172600	-0.55008300	0.21033100
H	-3.57618100	-0.07248300	2.28569600
O	-3.78302200	-1.08643000	-2.13516700
H	-4.71921000	-1.14917500	-1.90205900
O	-5.12263700	-0.72448700	0.16675200
H	-5.50857000	-0.58572300	1.03898200
O	3.44288200	2.06134600	-0.36398800
H	2.83920100	2.84359300	-0.40994800
C	-0.91245600	0.33461000	2.57559300
H	-0.05169400	-0.31542800	2.75299300

282	H	-0.53411000	1.36008100	2.51598000
283	H	-1.56795100	0.27355200	3.44605800
284	C	0.64585100	2.38957200	-0.29504400
285	O	1.30718800	3.42569300	-0.41721700
286	O	3.12511600	-2.65535100	0.07285000
287	C	4.54953000	-2.79830100	0.01135900
288	H	4.94017000	-2.42709400	-0.93967800
289	H	5.03220600	-2.27502300	0.84088100
290	H	4.73988100	-3.86588200	0.09272600
291	O	-0.69001100	2.45837100	-0.28716500
292	H	-0.92327300	3.39555200	-0.38159300

293 **Altenusin B**

294 0 1

295	C	3.28976200	-1.37272500	-0.36089900
296	C	2.33332000	-2.37702100	-0.33835400
297	C	0.97799900	-2.05497900	-0.18634700
298	C	0.57627500	-0.73693400	-0.03231700
299	C	1.53936600	0.31209000	-0.03428300
300	C	2.90604700	-0.03722500	-0.22381700
301	H	4.34258600	-1.59558500	-0.48980600
302	H	0.24576700	-2.85196700	-0.20174300
303	C	-0.90188700	-0.49701400	0.06351600
304	C	-1.59789900	-0.16090000	-1.10387000
305	C	-1.60144400	-0.67119900	1.26825800
306	C	-2.97459800	0.01569700	-1.08618500
307	H	-1.05758800	-0.03275500	-2.03641100
308	C	-2.98931600	-0.49184600	1.26756200
309	C	-3.68079600	-0.15191300	0.11137500

310	H	-3.55610900	-0.61184100	2.18444000
311	O	-5.03714700	0.01531900	0.14916600
312	H	-5.33028500	0.25579300	-0.74027300
313	O	-3.73812700	0.34560900	-2.18000600
314	H	-3.17939900	0.47392100	-2.95461000
315	O	3.91833200	0.85517600	-0.26454200
316	H	3.53906700	1.75260300	-0.23380500
317	O	2.64405500	-3.68983600	-0.47355500
318	H	3.59746700	-3.79547600	-0.58135800
319	C	1.10933400	1.70576700	0.22046000
320	O	0.05746700	2.06271200	0.69757200
321	O	2.06133600	2.62358500	-0.13862300
322	C	1.75871800	4.01214800	0.12800300
323	H	2.63443800	4.56553100	-0.20046800
324	H	0.87864700	4.31627200	-0.43734500
325	H	1.58420600	4.16243500	1.19297000
326	C	-0.88712700	-1.00573800	2.55651700
327	H	-0.36673000	-1.96574300	2.49722800
328	H	-0.13501200	-0.24744200	2.79427500
329	H	-1.59090200	-1.05551900	3.38908700
330	**Alterlactone**			
331	0 1			
332	C	1.40722900	-1.00523600	-0.14656800
333	C	2.81834300	-0.81798400	-0.29364400
334	C	3.39770600	0.42945200	-0.10463600
335	C	2.59696500	1.53829600	0.15903700
336	C	1.20505300	1.40010800	0.21143300
337	C	0.59962200	0.15033900	0.05602800

338	H	4.47092100	0.53860200	-0.18956700
339	H	0.57892500	2.26054900	0.39019000
340	O	3.25087300	2.70870500	0.33361000
341	C	2.49589600	3.89924000	0.58975300
342	H	3.23202600	4.69293400	0.69459900
343	H	1.82705500	4.12926200	-0.24363400
344	H	1.92082600	3.80967000	1.51502100
345	O	3.65128000	-1.83037400	-0.60185000
346	H	3.08627500	-2.59444200	-0.85951900
347	C	0.92053100	-2.39337100	-0.29205200
348	C	-0.88766000	0.12027100	0.05263100
349	C	-1.60096200	-0.89647800	0.70284200
350	C	-0.83618100	-2.00717400	1.34103100
351	H	-0.06957100	-1.64445400	2.02945300
352	H	-1.48612700	-2.70281700	1.86616800
353	O	-0.18888200	-2.82283300	0.32308500
354	O	1.53874500	-3.23725500	-0.94073500
355	C	-2.99763200	-0.87971900	0.72117900
356	C	-3.69648800	0.14358600	0.09749000
357	H	-3.54274100	-1.66888400	1.22875500
358	C	-1.60681700	1.14092000	-0.58966700
359	C	-2.99355700	1.15972700	-0.57230100
360	H	-1.09507500	1.92682800	-1.13050400
361	O	-3.66500800	2.15657700	-1.21159500
362	H	-4.61326600	1.99636100	-1.10760800
363	O	-5.05765100	0.25609200	0.05938800
364	H	-5.47639600	-0.48275700	0.51607700
365				

Dehydrolactone

0 1

C	2.50509000	1.15261900	-0.28279600
C	1.10500000	0.98481800	-0.17483600
C	0.58186900	-0.31776600	0.02638600
C	1.42992200	-1.40239100	0.15376400
C	2.82437000	-1.21431000	0.07791100
C	3.35877400	0.05336300	-0.14305500
H	1.05429300	-2.40048800	0.33310600
H	4.42249900	0.22557500	-0.21946300
C	0.22739500	2.13762200	-0.32884400
O	0.62606800	3.25472300	-0.64940500
O	-1.09478900	1.98481000	-0.13048700
C	-0.88073400	-0.44498600	0.05709200
C	-1.61838900	0.78382800	0.54845200
C	-1.38445300	0.97164100	2.06465600
H	-1.79491700	0.12163900	2.61150800
H	-0.31981800	1.05370100	2.28992000
H	-1.88905500	1.88141100	2.39314300
C	-3.09033800	0.78355200	0.27418800
H	-3.62492700	1.70273800	0.48343700
C	-1.54704400	-1.55497000	-0.31494800
H	-1.03202200	-2.45140000	-0.63855900
C	-3.73593700	-0.32559100	-0.10584900
C	-3.00314100	-1.58823500	-0.38620200
O	3.06227700	2.34846600	-0.51946100
H	2.32257700	2.99042600	-0.63867800

394	O	-3.64904000	-2.58229300	-0.71238300
395	O	-5.07195600	-0.39974900	-0.27565800
396	H	-5.24946700	-1.31891300	-0.54765700
397	O	3.56181700	-2.33134000	0.23138700
398	C	4.99203400	-2.23573500	0.17933300
399	H	5.36868800	-1.58365900	0.97132000
400	H	5.35639600	-3.24829100	0.33410600
401	H	5.32422800	-1.87041600	-0.79562900
402				
403				