Bioinformatics Study of Hibiscus Flower (*Hibiscus rosa-sinensis*) Against Diabetes

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Abstract. People often experience diabetes problems. Adequate and intensive treatment is expensive. Hibiscus flower (Hibiscus rosa-sinensis L) has potential as an alternative medicine for diabetes mellitus. The active ascorbic-acid compound with the name IUPAC (2R) -2 - [(1S) -1,2-dihydroxyethyl] -3,4-dihydroxy-2H-furan-5-one found in this part of the flower plays a role in treating disease diabetes mellitus. The purpose of this study was to determine the efficacy of hibiscus flowers for the health of the body. Hibiscus flowers are very useful including helping the healing process of diabetes mellitus because this plant contains ascorbic acid or vitamin C which is believed to be able to treat diabetes mellitus. The research method used is library research where data sources are obtained from primary data sources and secondary data sources. This method is a combination of descriptive, comparative, qualitative and quantitative methods.

1. Introduction

Hibiscus rosa-sinensis L is one of the plants believed to have originated in the Asian continent and then widely distributed in southeastern China and the Pacific Ocean. In Indonesia, hibiscus plants are called ornamental plants or hedges[1]. Adapted from Suryowinoto (1997) in Aprianty, N. and Kriswiyanti, E. (2008). Hibiscus (Hibiscus rosa-sinensis L.), also known as the plant name of the flower, and Wora-Wari bang belong to the Malvaceae family[2].

Diabetes is a series of symptoms that appear quantitatively and qualitatively in the human body due to the continuous (chronic) increase of blood sugar (glucose) levels due to lack of insulin. The pancreas is diseased, so it cannot produce insulin, the action of insulin is inhibited, or because the pancreas cannot produce insulin cell[3].

Scientists from northeastern India and West Bengal have discovered a potential natural chemical derived from hibiscus. This flower is considered a good cure for diabetes. An active ingredient of ascorbic acid, called IUPAC (2R)-2-[(La 1S)-1,2-dihydroxyethyl] -3,4-dihydroxy-2H-furan-5-one, in the flower It is found in this part that it plays an important role in the treatment of diabetes.

2. Methodology

This study uses a literature review method or the SLR (systematic literature review) approach to review studies, assess and interpret and collect information about the compounds contained in hibiscus flowers and their role in helping cure diabetes mellitus. To determine the content, phytochem was used, then chemdraw ultra 12.0 and chem 3 D pro 12.0 to make the structure of the compound that was already in https://pubchem.ncbi.nlm.nih.gov/ previously and to determine the parameters (internal and cartesian coordinate tables) besides that, http://swisstargetprediction.ch/ is also used to predict these compounds to be more active in healing diabetes mellitus.

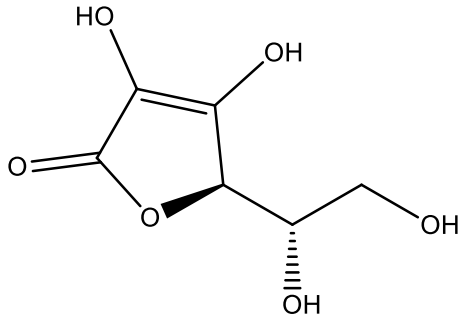
3. Result and Discussion

Chemical content in Hibiscus rosa-sinensis

ASCORBIC-ACID

IUPAC

(2R)-2-[(1S)-1,2-dihydroxyethyl]-3,4-dihydroxy-2H-furan-5-one



(2R)-2-[(1S)-1,2-dihydroxyethyl]-3,4-dihydroxy-2H-furan-5-one

Boiling Point: 779,24 [K]
Melting Point: 471,23 [K]
Critical Temp: 858,34 [K]
Critical Pres: 61,32 [Bar]
Critical Vol: 410,5 [cm3/mol]
Gibbs Energy: -789 [kJ/mol]
Log P: -3,36
MR: 36,61 [cm3/mol]
Henry's Law: 15,41
Heat of Form: -991,01 [kJ/mol]
tPSA: 107.22
CLogP: -1.7599
CMR: 3.6346

Before being optimized

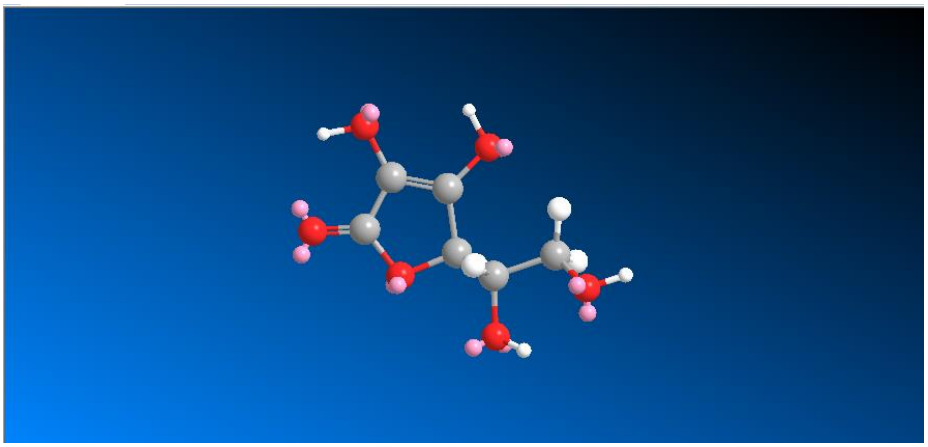
Cartesian table

Atom	X(A)	Y(A)	Z(A)
O(1)	-46.127	-11.244	-0.5619
C(2)	-33.221	-0.5766	-0.5619
C(3)	-35.563	0.9020	-0.5619
C(4)	-48.641	11.799	-0.5619
C(5)	-55.999	0.0469	-0.5619
O(6)	-68.056	-0.0282	-0.5619
O(7)	-53.826	24.318	-0.5619
O(8)	-25.734	18.347	-0.5619
C(9)	-25.539	-10.024	0.6823
C(10)	-11.821	-0.3408	0.6823
O(11)	-0.1865	-13.278	0.6823
O(12)	-24.013	-23.961	0.6823
H(13)	-27.134	-0.9140	-14.305
H(14)	-63.516	23.555	-0.5619
H(15)	-29.919	27.120	-0.5619
H(16)	-31.159	-0.6909	15.911
H(17)	-10.762	0.2923	15.915
H(18)	-10.761	0.2929	-0.2265
H(19)	0.6426	-0.8805	0.6823
H(20)	-32.674	-27.664	0.6823

Internal coordinate table

Atom	Bond Atom	Bond Lenght (A)	Angel Atom	Angle (º)	2nd Angle Atom	2nd Angle (º)	2nd Angle Type
C(3)							
C(4)	C(3)	13.370					
C(2)	C(3)	14.970	C(4)	1.110.000			
C(5)	C(4)	13.510	C(3)	1.110.000	C(2)	0.0000	Dihedral
O(1)	C(2)	14.020	C(3)	1.040.000	C(4)	-0.0000	Dihedral
O(7)	C(4)	13.550	C(3)	1.245.000	C(5)	1.245.000	Pro-S
O(8)	C(3)	13.550	C(2)	1.245.000	C(4)	1.245.000	Pro-S
C(9)	C(2)	15.230	O(1)	1.107.973	C(3)	1.107.973	Pro-S
O(6)	C(5)	12.080	O(1)	1.265.628	C(4)	1.265.628	Pro-S
C(10)	C(9)	15.230	C(2)	1.094.418	O(1)	-1.774.516	Dihedral
O(12)	C(9)	14.020	C(2)	1.094.418	C(10)	1.095.000	Pro-R
O(11)	C(10)	14.020	C(9)	1.095.000	C(2)	-1.199.636	Dihedral
H(13)	C(2)	11.130	O(1)	1.126.423	C(3)	1.126.423	Pro-R
H(16)	C(9)	11.130	C(2)	1.095.200	C(10)	1.094.618	Pro-S
H(17)	C(10)	11.130	C(9)	1.094.418	O(11)	1.094.418	Pro-R
H(18)	C(10)	11.130	C(9)	1.094.618	O(11)	1.094.618	Pro-S
H(14)	O(7)	0.9720	C(4)	1.080.000	C(3)	1.800.000	Dihedral
H(15)	O(8)	0.9720	C(3)	1.080.000	C(2)	-1.800.000	Dihedral
H(19)	O(11)	0.9420	C(10)	1.069.000	C(9)	-1.800.000	Dihedral
H(20)	O(12)	0.9420	C(9)	1.069.000	C(2)	-600.364	Dihedral

Once optimized



----------MM2 Dynamics----------
Pi System: 3 4 5 6
Warning: Some parameters are guessed (Quality = 1).
Iteration Time Total Energy Potential Energy Temperature

5	0.010	35.371 ± 0.141	25.838 ± 2.688	99.95 ± 29.35
10	0.020	35.580 ± 0.090	23.858 ± 0.530	122.89 ± 5.95
15	0.030	35.816 ± 0.071	24.573 ± 1.832	117.87 ± 19.37
20	0.040	36.010 ± 0.125	24.585 ± 2.859	119.78 ± 30.21
25	0.050	36.171 ± 0.079	24.075 ± 1.279	126.81 ± 13.50
30	0.060	36.320 ± 0.088	24.854 ± 0.689	120.21 ± 6.85
35	0.070	36.543 ± 0.052	24.511 ± 1.618	126.15 ± 16.83
40	0.080	36.737 ± 0.159	23.840 ± 2.018	135.21 ± 20.66
45	0.090	36.922 ± 0.078	22.981 ± 1.539	146.16 ± 15.94
50	0.100	37.072 ± 0.116	24.100 ± 1.787	136.00 ± 18.70
55	0.110	37.258 ± 0.106	23.130 ± 1.809	148.11 ± 19.16
60	0.120	37.441 ± 0.141	24.440 ± 0.680	136.29 ± 6.26
65	0.130	37.611 ± 0.191	22.511 ± 1.396	158.31 ± 14.24
70	0.140	37.780 ± 0.162	23.061 ± 1.028	154.32 ± 10.72
75	0.150	37.885 ± 0.118	24.144 ± 1.883	144.05 ± 19.72
80	0.160	38.148 ± 0.167	22.847 ± 0.791	160.42 ± 7.75
85	0.170	38.346 ± 0.098	23.054 ± 1.382	160.32 ± 13.71
90	0.180	38.496 ± 0.187	22.635 ± 1.294	166.28 ± 13.44
95	0.190	38.700 ± 0.116	21.222 ± 1.067	183.24 ± 10.59
100	0.200	38.877 ± 0.180	23.854 ± 0.672	157.50 ± 7.06

Translational Kinetic Energy: 0.0000 Rotational Kinetic Energy: 0.0018

Calculation completed

----------MM2 Dynamics----------

Pi System: 3 4 5 6

Warning: Some parameters are guessed (Quality = 1).

Iteration	Time	Total Energy	Potential Energy	Temperature
5	0.010	26.939 ± 0.129	19.016 ± 2.323	83.06 ± 25.17
10	0.020	27.134 ± 0.086	18.027 ± 0.896	95.47 ± 9.90
15	0.030	27.329 ± 0.059	17.932 ± 1.814	98.52 ± 19.30
20	0.040	27.541 ± 0.076	17.779 ± 2.794	102.34 ± 29.70
25	0.050	27.730 ± 0.074	17.424 ± 0.597	108.05 ± 6.98
30	0.060	27.944 ± 0.088	17.865 ± 0.786	105.67 ± 7.72
35	0.070	28.142 ± 0.076	17.818 ± 2.259	108.23 ± 23.47
40	0.080	28.297 ± 0.150	17.476 ± 2.032	113.44 ± 21.00
45	0.090	28.464 ± 0.080	18.428 ± 0.382	105.22 ± 3.81
50	0.100	28.643 ± 0.110	19.450 ± 1.469	96.37 ± 14.97
55	0.110	28.846 ± 0.152	18.982 ± 1.958	103.42 ± 20.03
60	0.120	29.035 ± 0.150	20.159 ± 0.621	93.06 ± 6.25
65	0.130	29.260 ± 0.206	18.525 ± 1.287	112.55 ± 13.45
70	0.140	29.466 ± 0.111	19.491 ± 1.413	104.58 ± 14.99
75	0.150	29.631 ± 0.185	19.791 ± 1.040	103.15 ± 10.54
80	0.160	29.864 ± 0.126	17.986 ± 1.183	124.53 ± 11.30
85	0.170	30.018 ± 0.171	18.867 ± 1.192	116.91 ± 12.23
90	0.180	30.216 ± 0.097	18.775 ± 1.127	119.95 ± 11.19
95	0.190	30.385 ± 0.115	18.282 ± 0.803	126.89 ± 8.63
100	0.200	30.587 ± 0.089	19.593 ± 0.923	115.27 ± 9.68

Translational Kinetic Energy: 0.0000 Rotational Kinetic Energy: 0.0022
Calculation completed

----------MM2 Minimization----------
Pi System: 3 4 5 6
Warning: Some parameters are guessed (Quality = 1).
Iteration 233: Minimization terminated normally because the gradient norm is less than the minimum gradient norm
Stretch: 0.9039
Bend: 10.1021
Stretch-Bend: -0.0545
Torsion: -1.6812
Non-1,4 VDW: -8.6688
1,4 VDW: 3.9694
Dipole/Dipole: 0.7591
Total Energy: 5.3301 kcal/mol
Calculation completed

Cartesian table

Atom	X(A)	Y(A)	Z(A)
O(1)	-35.414	-10.593	-0.6225
C(2)	-22.251	-0.5259	-0.7065
C(3)	-24.409	0.9673	-0.6654
C(4)	-37.453	12.198	-0.5637
C(5)	-43.703	0.0227	-0.5410
O(6)	-55.796	-0.0250	-0.4569
O(7)	-43.720	24.142	-0.5061
O(8)	-14.878	19.206	-0.7463
C(9)	-13.749	-10.606	0.4362
C(10)	0.0626	-0.5753	0.4245
O(11)	0.7837	-13.424	13.676
O(12)	-13.262	-24.651	0.3381
H(13)	-17.902	-0.8129	-16.921
H(14)	-53.268	22.300	-0.4637
H(15)	-19.444	27.798	-0.7265
H(16)	-18.455	-0.8197	14.183
H(17)	0.1548	0.4903	0.7262
H(18)	0.5435	-0.7262	-0.5672
H(19)	16.937	-10.432	14.106
H(20)	-0.6691	-27.836	0.9639
Lp(21)	-36.055	-12.773	-0.0687

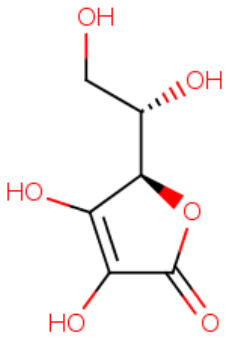
Lp(22)	-36.858	-12.651	-11.670
Lp(23)	-58.734	0.4975	-0.4264
Lp(24)	-58.407	-0.5666	-0.4493
Lp(25)	-42.767	27.331	-10.054
Lp(26)	-42.277	27.111	-0.0049
Lp(27)	-11.279	19.191	-0.2670
Lp(28)	-11.912	19.009	-12.676
Lp(29)	0.5671	-12.815	19.242
Lp(30)	0.8135	-19.211	12.121
Lp(31)	-18.432	-27.261	0.4970
Lp(32)	-11.360	-26.445	-0.2025

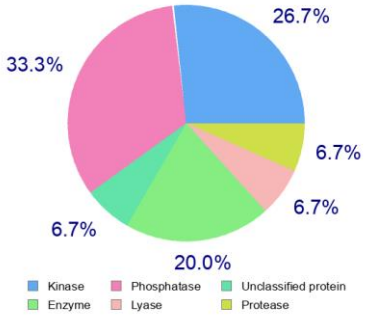
Internal coordinate table

Atom	Bond Atom	Bond Lenght (A)	Angel Atom	Angle (°)	2nd Angle Atom	2nd Angle (°)	2nd Angle Type
C(3)							
C(4)	C(3)	13.370					
C(2)	C(3)	14.970	C(4)	1.110.000			
O(1)	C(2)	14.020	C(3)	1.040.000	C(4)	0.0000	Dihedral
C(5)	C(4)	13.510	C(3)	1.110.000	C(2)	-0.0000	Dihedral
O(8)	C(3)	13.550	C(2)	1.245.000	C(4)	1.245.000	Pro-S
O(6)	C(5)	12.080	O(1)	1.265.628	C(4)	1.265.628	Pro-R
O(7)	C(4)	13.550	C(3)	1.245.000	C(5)	1.245.000	Pro-S
C(9)	C(2)	15.230	O(1)	1.107.973	C(3)	1.107.973	Pro-S
H(13)	C(2)	11.130	O(1)	1.126.423	C(3)	1.126.423	Pro-R
H(15)	O(8)	0.9720	C(3)	1.080.000	C(2)	1.800.000	Dihedral
Lp(21)	O(1)	0.6000	C(2)	1.095.919	C(5)	1.095.919	Pro-R
Lp(22)	O(1)	0.6000	C(2)	1.098.125	C(5)	1.098.125	Pro-S
C(10)	C(9)	15.230	C(2)	1.094.418	O(1)	-1.774.516	Dihedral
H(14)	O(7)	0.9720	C(4)	1.080.000	C(3)	1.800.000	Dihedral
Lp(23)	O(6)	0.6000	C(5)	1.200.000	O(1)	-1.800.000	Dihedral
Lp(24)	O(6)	0.6000	C(5)	1.090.000	O(1)	-0.0000	Dihedral
Lp(27)	O(8)	0.6000	C(3)	1.109.940	H(15)	1.109.940	Pro-S
Lp(28)	O(8)	0.6000	C(3)	1.131.060	H(15)	1.131.060	Pro-R
O(11)	C(10)	14.020	C(9)	1.095.000	C(2)	-1.199.636	Dihedral
O(12)	C(9)	14.020	C(2)	1.094.418	C(10)	1.095.000	Pro-R
H(16)	C(9)	11.130	C(2)	1.095.200	C(10)	1.094.618	Pro-S
Lp(25)	O(7)	0.6000	C(4)	1.097.700	H(14)	1.097.700	Pro-R
Lp(26)	O(7)	0.6000	C(4)	1.102.292	H(14)	1.102.292	Pro-S
H(17)	C(10)	11.130	C(9)	1.094.418	O(11)	1.094.418	Pro-R

H(18)	C(10)	11.130	C(9)	1.094.618	O(11)	1.094.618	Pro-S
H(19)	O(11)	0.9420	C(10)	1.069.000	C(9)	-1.800.000	Dihedral
H(20)	O(12)	0.9420	C(9)	1.069.000	C(2)	-600.364	Dihedral
Lp(29)	O(11)	0.6000	C(10)	1.096.802	H(19)	1.096.802	Pro-S
Lp(30)	O(11)	0.6000	C(10)	1.100.189	H(19)	1.100.189	Pro-R
Lp(31)	O(12)	0.6000	C(9)	1.105.249	H(20)	1.105.249	Pro-S
Lp(32)	O(12)	0.6000	C(9)	1.120.011	H(20)	1.120.011	Pro-R

Structure prediction





Target	Common name	Uniprot ID	ChEMBL ID	Target Class	Probability*	Known actives (3D/2D)
Glycogen synthase kinase-3 beta	GSK3B	P49841	CHEMBL262	Kinase		0 / 2
Protein kinase C alpha	PRKCA	P17252	CHEMBL299	Kinase		0 / 168
Protein-tyrosine phosphatase 1B	PTPN1	P18031	CHEMBL335	Phosphatase		0 / 9
T-cell protein-tyrosine phosphatase	PTPN2	P17706	CHEMBL3807	Phosphatase		0 / 1
Dual specificity phosphatase Cdc25B *(by homology)*	CDC25B	P30305	CHEMBL4804	Phosphatase		0 / 3
Low molecular weight phosphotyrosine protein phosphatase	ACP1	P24666	CHEMBL4903	Phosphatase		0 / 1
Programmed cell death protein 4	PDCD4	Q53EL6	CHEMBL1781868	Unclassified protein		0 / 8
Tubulin--tyrosine ligase	TTL	Q8NG68	CHEMBL5549	Enzyme		0 / 9
Dual specificity protein phosphatase 3	DUSP3	P51452	CHEMBL2635	Phosphatase		0 / 1
Protein kinase C delta	PRKCD	Q05655	CHEMBL2996	Kinase		0 / 22
Isoleucyl-tRNA synthetase	IARS	P41252	CHEMBL3235	Enzyme		0 / 1
Glutathione S-transferase Mu 1	GSTM1	P09488	CHEMBL2081	Enzyme		0 / 1
Protein kinase C epsilon	PRKCE	Q02156	CHEMBL3582	Kinase		0 / 25
Carbonic anhydrase II	CA2	P00918	CHEMBL205	Lyase		1 / 0
Glutamate carboxypeptidase II	FOLH1	Q04609	CHEMBL1892	Protease		1 / 0

Hibiscus has many properties that can replace herbal diseases, one of which is anti-diabetic[4]. The content of Hibiscus rosa-sinensis contains the active ingredient ascorbic acid, this compound can play a role in the treatment of diabetes and has a predictive target for ascorbic acid, which contains glycogen synthase kinase-3 beta

4. Conclusion

Based on research conducted by several people and several literature reviews, hibiscus flower as a traditional medicine has many properties, including it can help in the process of treating diabetes. This is because in hibiscus flowers there is a content of ascorbac acid contained in it glycogen synthase kinase-3 beta which can treat diabetes mellitus.

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