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COMPUTER AIDED CONFORMATIONAL ANALYSIS OF SULFONATED AZO DYES DIAMMONIUM ORANGE G ($C_{16}H_{10}N_2O_7S_2$ (NH_4). $4H_2O$

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The present work describes the conformational analysis of diamomonium orange G ($C_{16}H_{10}N_2O_7S_2(NH_4)$. $4H_2O$) by using kitaigorodsky function. The minimum potential energy was found to be -0.0099839 at ω1=16o^{o}and ω 2=360^o.

Keywords: Conformational analysis, sulfonated azo dyes, Kitaigorodsky function.

INTRODUCTION

Silfonated azo dies are compound of considerable interest by virtue of their importance and versatility in biomedical application, these dyes also posses important pharmaceutical properties. The sulfonated azo-dye Congo red, bind to amyloid proteins those implicated in such neurodegenerative conditions as scrapie and Alzheimer's disease, This binding interaction with amyloid made congo red a compound of active biomedical interest. Sulfonated azo dye, Evans blue, demonstrates antiviral activity agent and has been examined as a potential anti HIV agent. Both Evans Blue and Congo Red, in addition to several other sulfonated azo, dye has been shown to inhibit HIV-1 protease. The pharmaceutical properties, sulfonated azo dyes have recently used systematically for cocrystallizing and coprecitating peptides and other biomolecules. Diammonium, dilithium, magnesium, and calcium salt of 7-hydroxy-8- (phenylazo)-1,3-naphalenedisulfonic acid, the compound, which in the form of its disodium salt commonly known as Orange G. Its crystallizes in triclinic system with unit cell dimension a=9.586, b=10.495, c=14.208 with space group P1 (William *et al.,* 1994). The present work describes the computer aided conformational analysis of similar to other drug (Naheed *et al*., 2001; Naheed *et al*., 1999; Farhat *et al*., 2003; Haleem and Meena, 1988; Waseem *et al*., 2003 and Haleem and Saify, 1989).

METHOD

The three dimensional quantitative structure activity relationship (3D.QSAR) provided the valuable information about the nature of the receptor (Benjamin *et al*., 1994; Mathias *et al*., 1987; Asim *et al*., 2001 and Greendidge *et al*., 1992). Its help to describe new drug candidates and help to improve in vitro potency (Manuel *et al*., 1992).

The potential energy calculated by using Kitaigorodsky function (Kitaigorodsky, 1961). In order to determine e the allowed conformation the contact distance between the atom in the adjacent residues have to be examined using criteria for minimum vander Waal's contact distances.

If Xm, Ym, Zm are the coordinates in the monoclinic system then coordinates the rectangular system can be calculated by the following relationship:

Xr = Xm+Zm cos β
Yr = Ym
Zm = Zmsinβ

Where Xr, Yr, Zr are the coordinates in the rectangular system. The coordinates of the atoms in the two residues were calculated with respect to a suitable chosen fixed co-ordinates system, from which the various contact distances were calculated. Contact distance and potential energies were calculated for varies of ω1 and ω2 (are the angle of rotation) the detailed mathematical calculations are given elsewhere (Haleem *et al*., 1986 and Waseem *et al*., 2003). Total potential energies were calculated by summation of all individual pairs. Contour are plotted for visual understanding.

RESULT

The prospective view of diagram is shown in (fig.1).

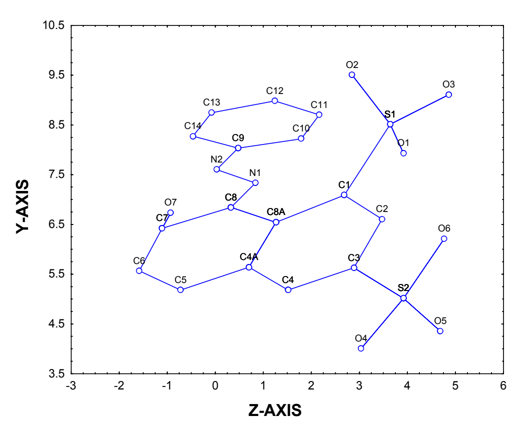

Fig. 1: 010 Rojection of sulfonated azo dyesdiammonium orange G.

The potential energies were calculated for upper limit (K1). The energy estimates for the following pairs. The minimum potential energies are shown by negative mark. Monoclinic coordinates of drug are given in table 1.1. Bonds length and bond angle are given in tables 1.2 and 1.3 respectively.

Table 1

Monoclinic coordinates of sulfonated azo dyes diammonium orange G ($C_{16}H_{10}N_2O_7S_2$ (NH_4). $4H_2O$

Atoms	X	Y	Z
S(1)	6.1508	8.51141	3.64149
S(2)	10.06541	5.014846	3.92001
O(1)	4.095276	7.928023	3.917362
O(2)	6.018198	9.108134	4.859194
O(3)	6.92187	9.108134	4.859194
O(4)	10.96418	4.00459	3.03615
O(5)	9.214007	4.357487	4.68394
O(6)	10.79741	6.214086	4.765893
O(7)	5.713887	6.731945	-1.929052
O(8)	7.052128	12.15282	4.150614
O(9)	9.261416	10.69713	5.720332
O(10)	9.49549	1.396546	4.132962
O(11)	4.592816	5.926196	5.337044
N(1)	5.041901	7.333592	0.8334009
N(2)	4.162194	7.602944	0.027738
N(3)	6.437564	3.644117	4.769676
N(4)	10.36672	4.71803	7.290051
C(1)	7.158613	7.088102	2.685543
C(2)	8.048874	6.605146	3.472294
C(3)	9.008407	5.627821	2.886013
C(4)	9.141825	5.17994	1.154243
C(4A)	8.255958	5.639567	0.7035366
C(5)	8.452716	5.180362	-0.7224489
C(6)	7.65361	5.56498	-1.581066
C(7)	6.493933	6.42336	-1.105738
C(8)	6.229105	6.842852	0.3278128
C(8A)	7.184868	6.541856	1.26334
C(9)	2.864411	8.033653	0.4740677
C(10)	2.475873	8.22133	1.78784
C(11)	1.195984	8.700943	2.164825
C(12)	0.322469	8.980882	1.238124
C(13)	2.782509	8.743836	-0.0760991
C(14)	1.997034	8.272504	-0.4665028
H(2)	7.982752	6.95278	4.400256
H(2N)	4.33819	7.4636	-0.7312746
H(3A)	5.864848	4.341141	5.055881
H(3B)	6.321257	2.915278	5.06849
H(3C)	7.255194	4.026828	5.005449
H(3D)	6.403447	3.318675	3.858104
H(4)	9.835969	4.495682	1.021263
H(4A)	9.987754	4.820685	6.467998
H(4B)	9.811718	4.306311	7.690992
H(4C)	11.17203	4.191863	7.174056
H(4D)	10.59544	5.634991	7.7036
H(5)	9.208614	4.505191	-1.084304
H(6)	7.820652	5.257772	-2.572069
H(8W)	6.856108	11.33817	3.845496
H(8A)	6.556163	12.5211	3.795063
H(9W)	8.735711	10.30484	5.3694
H(9A)	9.224903	10.92777	6.707553
H(10)	3.092591	8.004535	2.307298
H(10W)	10.02191	1.060222	3.820279
H(10A)	9.519751	2.325189	4.362431
H(11W)	4.794922	6.700394	4.99284
H(11)	0.8952094	8.886124	3.139438
H(11A)	3.973765	5.882129	5.245004
H(12)	-0.6207311	9.289619	1.52559
H(13)	0.1268716	9.010616	-0.6682336
H(14)	2.259033	8.05461	-1.349076

Table 2

Bond length of sulfonated azo dyes diammonium orange g ($C_{16}H_{10}N_2O_7S_2$ (NH_4). $4H_2O$

Atoms	Bond length
S(1)………………..O(1)	1.1418132
S(1)………………..O(2)	1.276558
S(1)……………..…O(3)	1.556359
S(2)……………..…O(5)	1.302054
O(7)………………C(7)	1.175391
O(8)……………....H(8W)	0.8917275
O(8)……………....H(8A)	0.7127602
O(9)……………....H(9W)	0.7372771
O(9)……………....H(9A)	1.014463
O(10)……………..H(10W)	0.6987503
O(10)…………..…H(10A)	0.9568883
O(11)…………..…H(11W)	0.8710376
O(11)……………..H(11A)	0.6274056
N(1)……………....N(2)	1.222918
N(1)……………....C(8)	1.380543
N(2)……………....C(9)	1.438388
N(2)……………...H(2N)	0.791519
N(3)……………...H(3A)	0.9464461
N(3)……………...H(3B)	0.7962559
N(3)……………...H(3C)	0.9330468
N(3)…………..…..H(3D)	0.9685241
N(4)……………...H(4A)	0.9110008
N(4)……………...H(4B)	0.7989307
N(4)………………H(4C)	0.9689321
N(4)…………..….H(4D)	1.031585
C(1)………………C(2)	1.279027
C(1)………………C(8A)	1.523724
C(2)………………C(3)	1.493055
C(2)………………H(2)	0.9933492
C(3)……………....C(4)	1.44919
C(4)………… ….C(4A)	1.285792

Atoms	Bond length
C(4)…………… H(4)	1.092279
C(4A)…………… .C(5)	1.510971
C(4A)……………..C(8A)	1.508224
C(5)……… ……..C(6)	1.234583
C(5)……………….H(5)	1.076155
C(6)……………….C(7)	1.518787
C(6)……………....H(6)	1.05104
C(7)……………….C(8)	1.516962
C(8)……………….C(8A)	1.370873
C(9)… …………..C(10)	1.382817
C(9)………………..C(13)	0.9025772
C(9)………………..C(14)	1.3015663
C(10)………………C(11)	1.417837
C(10)…………… .H(10)	0.8349713
C(11)……………....C(12)	1.303906
C(11)……………….H(11)	1.036642
C(12)…………….…H(12)	1.033239
C(13)……………….C(14)	0.9954436
C(13)……………….H(14)	1.53857
C(14)………………..H(14)	0.9460742
H(3A)……….……...H(3B)	1.497182
H(3A)………………H(3C)	1.426323
H(3B)………………H(3C)	1.453189
H(3B)………………H(3D)	1.278483
H(3C)………………H(3D)	1.594789
H(4A)…………..…..H(4B)	1.338388
H(4A)……… …..…H(4C)	1.5154
H(4A)……………....H(4D)	1.599727
H(4B)……………….H(4C)	1.459712
H(4B)……………….H(4D)	1.542666
H(8W)………………H(8A)	1.221407
H(9W)…………..…..H(9A)	1.54271
H(10W)…………..….H(10A)	1.465002
H(11W)… …………H(11A)	1.186358

Table 3
Bond angle of sulfonated azo dyes diammonium orange G $C_{16}H_{10}N_2O_7S_2$ (NH_4). $4H_2O$

Atoms	Bond angle
O(1)………....S(1)……………O(2)	110.0627
O(1)……….....S(1)……………O(3)	116.2911
O(2)…… ……S(1)…………..O(3)	104.0047
H(8W)…….…O(8)……… ….H(8A)	98.56637
H(9W)….… .O(9)……… ….H(9A)	122.6824
H(10W)… …O(10)…… . …H(10A)	123.742
H(11W)…..…..O(11)……… ..H(11A)	103.5279
N(2)…………..N(1)…………C(8)	117.1309
N(1)……….…N(2)……… …C(9)	120.725
N(1)……….…N(2)……… …H(2N)	115.6858
C(9)…………..N(2)……… …H(2N)	123.4509
H(3A)……. …N(3)…… … ..H(3B)	118.2046
H(3A)…. . ….N(3)… …… .H(3D)	98.76258
H(3A)… …....N(3)……… H(3D)	120.7389
H(3B)…………N(3)…… ….H(3C)	114.1444
H(3B)… …….N(3)……… ..H(3D)	92.35599
H(3C)… …N(3)……..… H(3D)	114.0134
H(4A)…………N(4)…………H(4B)	102.8541
H(4A)……..…..N(4)…………H(4C)	107.421
H(4A)……. …N(4)……….....H(4D)	110.7494
H(4B)………. .N(4)……..… H(4C)	110.9805
H(4B)… …….N(4)…….. …H(4D)	114.2901
H(4C)…… …N(4)……… .H(4D)	110.2946
C(2)………..…C(1)……..…..C(8A)	115.2933
C(1)…………...C(2)…… ….C(3)	116.9461
C(1)… ……..…C(2)…………H(2)	113.5627
C(3)……………C(2)………...H(2)	129.562
C(2)……………C(3)…… …C(4)	129.3217
C(3)………….. .C(4)……… .C(4A)	115.0453
C(3)………..…..C(4)…………H(4)	132.8107
C(4A)……… ..C(4)…………H(4)	112.1878
C(4)………… ..C(4A)… ……C(5)	113.3917
C(4)…… ….C(4A)……….C(8A)	118.0014
C(5)……………C(4A)…….…C(8A)	128.6738
C(4A)…………C(5)……… .C(6)	118.5297
C(4A)…………C(5)…………H(5)	126.8548
C(6)……….. ….C(5)…… … H(5)	114.6409
C(5)……………C(6)……… ..C(7)	116.9486
C(5)…………....C(6)…… …..H(6)	117.5113
C(7)………..…..C(6)……… ..H(6)	125.6001
O(7)…………....C(7)……… ..C(6)	115.8622
O(7)……………C(7)…… ..C(8)	118.2856
C(6)…………..…C(7)……… .C(8)	125.8427
N(1)……….……C(8)…………C(7)	126.4996
N(1)……………C(8)……..…..C(8A)	115.3464
C(7)……………C(8)……..…..C(8A)	117.5721
C(1)……………C(8A)………..C(4A)	124.9918
C(1)…………....C(8A)….. …..C(8)	123.1312
C(4A)………… C(8A)……… .C(8)	111.9393
N(2)………..…..C(9)…………C(10).	126.1046
N(2)…………....C(9)…………C(13)	97.39083
N(2)………..…..C(9)……..… .C(14)	115.6194
C(10)… … …..C(9)…………C(13)	116.6206
C(10)………… .C(9)…………C(14)	118.3459
C(13)………….…C(9)……..……C(14)	229.7389
C(9)……………C(10)………..C(11)	123.5381
C(9)……………C(10)……..…H(10)	110.4109
C(11)………..…C(10)… ……H(10)	126.1192
C(10)………..…C(11)………..C(12)	119.2597
C(10)…………...C(11)………..H(11)	124.9342
C(12)……… .C(11)………..H(11)	115.8404
C(11)……..……C(12)………..H(12)	118.5771
C(9)……………C(13)……… .C(14)	266.4082
C(9)………..…..C(13)………. .H(14)	100.5844

Atoms	Bond angle
C(14)…… ……C(13)…… …H(14)	216.458
C(9)………… .C(14)…… ….C(13)	223.7806
C(9)……… ….C(14)…… ….H(14)	116.5977
C(13)…………..C(14)…………H(14)	104.8417
N(3)………… ..H(3A)… …….H(3B)	207.945
N(3)…………....H(3A)…… …..H(3C)	220.2683
H(3B)…… …..H(3A)………..H(3C)	239.8504
N(3)…………….H(3B)…… ..H(3A)	213.8504
N(3)…………..…H(3B)… ……H(3C)	215.8607
N(3)…………….H(3B)……..…H(3D)	229.175
H(3A)…………..H(3B)…. ..….H(3C)	237.7741
H(3A)…………..H(3B)……...…H(3D)	253.1801
H(3C)………..…H(3B)… … H(3D)	251.0824
N(3)…………….H(3C)……..…H(3A)	220.9691
N(3)……..………H(3C)………..H(3B)	209.9949
N(3)…………..…H(3C)……..….H(3D)	213.6874
H(3A)…………..H(3C)………..H(3B)	242.6235
H(3A)………..…H(3C)…..……H(3D)	446.5625
H(3B)…………..H(3C)……….H(3D)	229.3115
N(3)…………….H(3D)..……….H(3B)	218.469
N(3)…………..…H(3D)…… …H(3C)	212.2993
H(3B)……..……H(3D)…..……H(3C)	239.5337
N(4)………… ..H(4A) ………H(4B)	215.5804
N(4)……… …..H(4A)…..……H(4C)	217.5859
N(4)…………..…H(4A)………..H(4D)	217.0799
H(4A)…………..H(4B)……...…H(4C)	241.1306
H(4A)…………..H(4B)………..H(4D)	242.5754
H(4C)………..…H(4B)………..H(4D)	243.5175
N(4)…………..…H(4C)………..H(4A)	221.5655
N(4)…………….H(4C)……..….H(4B)	218.2928
H(4A)…………..H(4C)………..H(4B)	217.5478
H(4A)…………..H(4B)………..H(4C)	245.3888
H(4A)………..…H(4B)………..H(4D)	246.9956
H(4C)…………..H(4B)………..H(4D)	246.2056
N(4)…………….H(4C)………..H(4A)	214.9931
N(4)…………….H(4C)………..H(4B)	210.7267
H(4A)…………..H(4C)………..H(4B)	233.4082
N(4)…………….H(4D)……….H(4A)	212.1707
N(4)…………….H(4D)……….H(4B)	208.1621
H(4A)…………..H(4D)………..H(4B)	230.3566
O(8)…………..…H(8W…… ..H(8A)	215.2324
O(8)…………..…H(8A)… …….H(8W)	226.2012
O(9)…………….H(9W)… ……H(9A)	213.602
O(9)…………….H(9A……...…H(9W)	203.7156
O(10)………..…H(10W)…..….H(10A)	212.894
O(10)…………..H(10A)……. .H(10W)	203.364
O(11) …………H(9W)……… H(11A)	210.9345
O(11)………..…H(11A)……...H(11W)	225.5376
C(13)…………...H(14)…………C(14)	218.7003

SET1

Total potential energy calculated for the pairs O1…C11, O1…C12 after rotating the O1 atom about the bond C1…. S1 (ω1) and C11andC12 atom about the bound C9…. C10 (ω 2) the minimum potential energy was found to be -0.0099839 k.cal/mol at ω1=160° and ω2=360° (fig. 2)

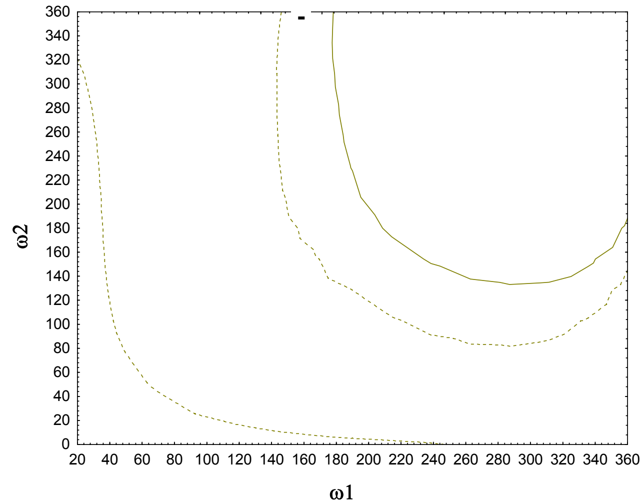

Fig. 2: Total potential energy contour for set 1.

SET2

Total potential energy calculated for the pairs O1…C3, O1…C4 after rotating the O1 atom about the bond C1…. S1 (ω1) and C3 and C4 atom about the bound C1…. C2 (ω 2) the minimum potential energy was found to be -0.0082397k.cal/mol at ω1=0°, ω 2=180° (Fig. 3).

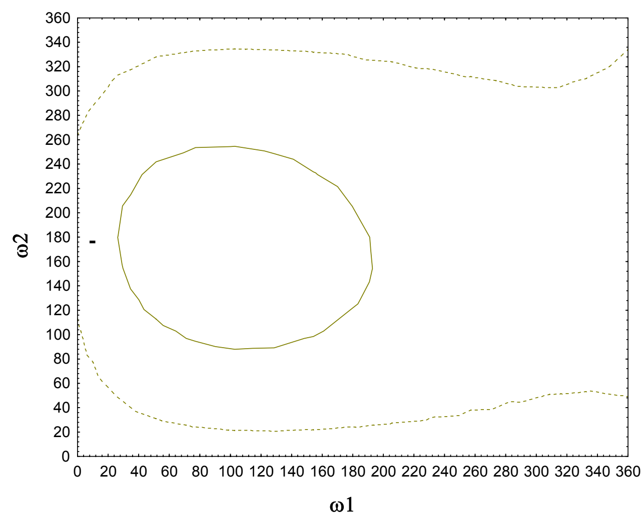

Fig. 3: Total potential energy contour for set 2.

SET3

Total potential energy calculated for the pairs O1…C1, O1…C12 after rotating the O1 atom about the bond C1….

S1 (ω 1) and C1 and C12 atom about the bound N2…. C9 (ω 2) the minimum potential energy was found to be - 0.099823k.cal/mol at ω1=40°, ω2=120° (fig. 4).

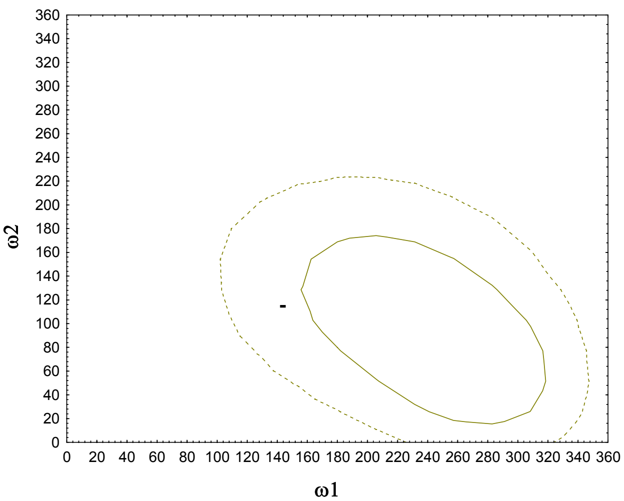

Fig. 4: Total potential energy contour for set 3.

DISCUSSION

The allowed region i.e. the region in which the drug can bind with receptor is shown in figs. 2, 3, 4. The area out side the zero line is allowed region. It is possible that drug in this conformation interact with receptor. The results indicate that it can only exist at one stable conformation and stable conformation exists at minimum potential energy. The minimum potential energy is found to be -0.0099839 at ω1= 160° and ω2=360° (fig.2). So this conformation of diammonium orange G will more active as antiviral drug. It will bind its receptor readily i.e. this conformation of drug may bind with receptor.

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