Density Functional Theory (Dft,B3lyp/6-31g) Of Acyclovir And Some Its Derivatives

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Abstract*: In this study the density theory (DFT) Ab initio quantum chemistry methods and Gaussian 09) program were applied to the calculation of the balanced geometry (bond lengths, length angles in Angstrom) of acyclovir (2-amino-9-(2-hydroxyethoxymethyl)-1H-purin-6-one Some its Derivatives Methylacyclovi (2-Amino-9-[(2-hydroxyethoxy)methyl]-1-methyl-1,9-dihydro-6H-purin-6-one) and Ganciclovir (2-amino-9-(((1,3-dihydroxypropan-2-yl)oxy)methyl)-1,9-dihydro-6H-purin-6-one) .The thermodynamic functions (E0 , H0 ,A0 ,S0 ,CV) was calculated of compounds studied and also some physical properties (EHOMO,ELUMO , ∆E , IP) was also calculated . The research paper concluded that the (2-amino-9-(((1,3-dihydroxypropan-2-yl)oxy)methyl)-1,9-dihydro-6H-purin-6-one) ganciclovir compound has the larger HOMO-LUMO gap and larger thermodynamic functions Compared to the compounds studied this always indicates to higher kinetic stability and lower chemical reactivity.

Keyword: theoretical study, Acyclovir.

INTRODUCTION

Acyclovir, is a synthetic analogue of a purine nucleoside, guanosine, with strong antiviral activity against herpes simplex viruses 1 and 2, and other viruses of the herpes virus family, It transforms in the human body when consumed to the active metabolite acyclovir by viral thymidine kinase . Acyclovir can inhibit the DNA polymerase of viruses by being integrated into the DNA chain of the growing virus, ending and stopping further polymerization **(1)** . Symbolized by ACV, is one of the most common antiviral drugs. It is used specifically to treat herpes simplex virus infection as well as treatment of herpes zoster infection . It has the brand names Cyclovir, Herpex, Acivir, Acivirax, The discovery of acyclovir led to the beginning of a new era in the manufacture of antiviral drugs as this antiviral is very specific **(2)** . Acyclovir is poorly soluble in water and has little biological dependence (10-20%) , for this reason , the drug is administered intravenously when a high concentration of the drug is required in the blood .The drug has a half-life of about 3 hours, and it is eliminated by the body through glomerular filtration and tube excretion **(3)** . Acyclovir is a primary drug against viruses, as it is converted to a more effective active state by using human enzymes and viruses inside the cell , the active form is used to manufacture DNA **(4)** , so that the formation of the deoxyribonucleic acid DNA stops in the cells and in this way acyclovir works to infect the virus and fight viral infection **(5)** **.** The completion of the acetyl development process leads to the achievement of goals in the development of anti-virus materials the results of a modification in the structure of the adductor nucleosides were released **(6)**. Acyclovir is an ox purine that is guanine substituted bya (2-hydroxyethoxy) methyl substituent at position · It is an ox purine and a member of 2-aminopurines . The metabolism of acyclovir to its monophosphate, diphosphate and triphosphate derivatives has been tested in virus-uninfected and infected cells **(7)**. Aciclovir is an acyclic nucleoside analogue, and it is incorporated into viral DNA inside an infected cell where it interferes

with viral replication .The level of phosphorylation of acyclovir depends on the cell type and the external drug , virus type drug concentration , and exposure time. Acyclovir triphosphate continued until the drug started in the middle, as the initial half-life of triphosphate was 1.2 hours after the drug was absent, but the triphosphate levels reached a plateau after 6 hours concentrations of the drug in the medium resulted in a longer , this resulted in the persistence of the triphosphate within the cells and a higher plateau level [8,9] . Acyclovir is a synthetic isotope of the purine nucleoside, guanosine , with strong anti-viral activity herpes virus 1, 2 [10], where it is converted into to the active metabolite acyclovir triphosphate by viral thymidine kinase . Acyclovir competitively inhibits virus DNA polymerase in the growing viral DNA chain terminating further polymerase [11] . Despite the widespread use of acyclovir, there is little evidence that indicates liver injury as a result of oral administration, and that taking the drug at high levels intravenously impairs liver function and elevates ALT levels in the blood . Acyclovir is not activated in cells that do not contain viral kinases, and this may explain the absence or rarity of hepatic injury [12] . Acyclovir is slowly absorbed from the gastrointestinal it is widely distributed into tissues and body fluids Renal excretion is the major route of elimination of acyclovir [13] . Ganciclovir and mtheylcyclovir are antiviral drug that are derived from acyclovir or sodium salt to treat CMV infection and is given by injection or orally they are commonly associated with a range of serious hematological adverse effects such us granulocytopenia , neutropenia, anemia, thrombocytopenia, increased serum creatinine and blood urea concentrations[14]. Ganciclovir is a synthetic analogue of 2′-deoxy-guanosine, phosphorylation is first performed into ganciclovir monophosphate by a viral kinase encoded by the UL97 cytomegalovirus (CMV) phylogeny, then , cellular kinases stimulate the formation of ganciclovir , mtheylcytopenia diphosphate and then triphosphate which competitively inhibits incorporation of deoxyguanosine triphosphate into elongating DNA . Short subgenomic which is present in 10-fold greater concentrations in cells infected with herpes virus or cytomegalovirus .Genotoxicity studies of acyclovir have yielded largely negative results , high concentrations of the compound were required for treatment the genotoxic effects of acyclovir are primarily related to its composition [15,16] .

MOLECULAR QUANTUM MECHANICS CALCULATION

Computational chemistry is an interaction between chemistry and computer in order to give quick and urgent solutions to some complex problems in chemistry. Physicists and chemists use these theoretical methods to predict and obtain initial information before practical procedures. The search for a wave function available on describing molecules, atoms is the essence of quantum chemistry, methods are its beating heart, and the quantum solution requires finding a set of steric variables that give the least energy possible [16]. The *Hartree-*Fock (HF) method is the basis used in computational quantum calculations, which is considered one of the branches of theoretical chemistry that aims to devise mathematical approximations to solve chemistry problems in the fastest time and with the least effort and to develop algorithms that calculate the properties of molecules such as total energy, dipole moment, vibration frequency and other properties. In general terms, molecular quantum calculations can be divided into [17].

1- Semi-empiracal methods
2- Ab-Initio methods

Semi-empiracal methods

In this type of calculations, the energy factor is simplified and approximated instead of solving its integrals, which leads to ease in performing the calculations and thus large molecules can be studied [17].

Ab initio methods

Ab initio quantum chemistry methods are computational chemistry methods based on quantum chemistry . *Ab initio* has been used in quantum chemistry by Robert Barr during excited states of benzene, this method uses *Hartree*-Fock equations (HF) and Roothaan-***Hall*** (R-H) equations without neglecting or approximating any of the integrals , as it does not depend on equations in practice[19] , but rather relies on the use of physical constants, and this method is more accurate than semi-experimental methods , it requires a lot of time and a computer device that has a huge memory and speed high , despite the intricacies of ab initio methods it is widely used in theoretical computation physical characteristics, such as the geometric shape, thermodynamic functions and spectral studies , gave the best solutions complex molecular solutions of an organic, inorganic and biotic nature, free radicals and ions [18].

Density Functional Theory (DFT)

It is one of the quantum chemistry methods used in physics and chemistry to verify the electronic structure of a multi-particle system. In this theory the concept of the function of the electron density was used instead of the wave function in the Schrödinger equation, where no" ψ "any physical meaning but a square . " ψ^2 " indicates the possibility of the presence of an electron in the region surrounding the nucleus and in the region that is The electronic density is as large as possible . The theory of the density function is accurate and revolves around the Kohn Sham equations regardless of the approximation of Born- oppenheiner when we measure the electronic density[19], it accurately represents the density of a system composed of " N " of electrons in direct influence. The energy of a steady-state system of a multi -system can be challenged based on the electronic charge densityIn mathematical terms[20]

$E_0[\rho(r)]$ ……...(1)

Where **E_0** Steady-state energy of a multi-particle system depending on the electronic charge density , **ρ(r)** electron density **.**

In Density functional theory (DFT) , the ground state energy functional is written by "Kohn and Sham, 1965" :

$$E_0[\rho(r)] = \int V_{EX}(r)p(r)dr + \int E_{KE}[p(r)] + \int E_H[p(r)] + \int E_{xc}[p(r)] \ldots (2)$$

$V_{ex}(r)\,p(r)dr$	External potentials energy
$E_{KE}[p(r)]$	Kinetic energy term for an equivalent system of no interacting
$E_H[p(r)]$	Hartree term, is given by the electron-electron repulsive interactions
$E_{xc}[p(r)]$	Exchange –correlation energy
∇^2	Laplace operator

$$\int V_{ex}(r)p(r)dr = -\int \sum_{i=1}^{N} \frac{p(r_2)}{|r_1 - r_2|} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

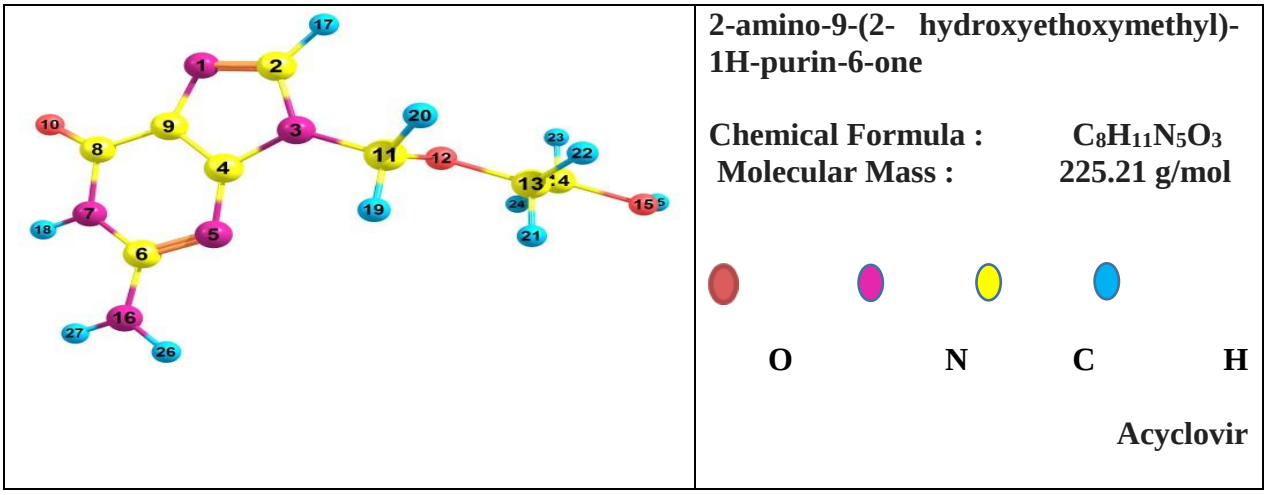
$$E_{KE}[p(r)] = \sum_{i=1}^{N} \int \varphi i(r) \left(-\frac{\nabla^2}{2}\right) \varphi i(r) dr \quad \ldots\ldots (4)$$

$$E_H[p(r)] = \frac{1}{2} \iint \frac{p(r_1)p(r_2)}{|r_1 - r_2|} \, d\,r_1 \, d\,r_2 \quad \ldots\ldots\ldots\ldots (5)$$

$$E_{xc}[p(r)] = \int p(r)\, E_{XC} p(r) dr \qquad \text{.....(6)}$$

GAUSSIAN SERIES OF PROGRAMS

The Gaussian series package is considered one of the best software in computational



chemistry that was first released by John Pople in 1970 and his research group at Carnegie Mellon University as Gaussian 70and launched it as Gaussian 70, where Gaussian orbits were used instead of slitter orbital orbits to speed up calculations and it was used to improve the performance of limited computing for devices computer in *Hartree*-Fock calculations, Then the program was developed up to Gaussian03 and then Gaussian09, Gaussian16 . This program is characterized by high accuracy in calculations of balanced geometric shape and spectral properties[23,24] **.**

RESULT AND DISCUSSION

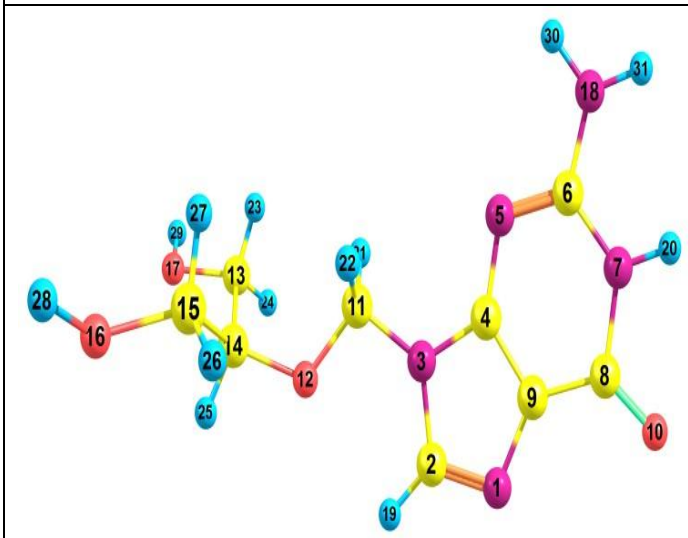
Geometric Paramedic

In this paper, the geometric shape was calculated(bond lengths and bond angels) of the the Acyclovir and some derivatives using DFT (density functional theory) According to the results calculated and recorded in the **(table 1 , Fig 1)**

Acyclovir	**$C_8H_{11}N_5O_3$**	**(2-amino-9-(2- hydroxyethoxymethyl)-1H-purin-6-one)**
Methylacyclovir	**$C_9H_{13}N_5O_3$**	**(2-Amino-9-[(2-hydroxyethoxy)methyl]-1-methyl-1,9- dihydro-6H-purin-6-one)**
Ganciclovir	**$C_9H_{13}N_5O_4$**	**(2-amino-9-(((1,3-dihydroxypropan-2-yl)oxy)methyl)-1,9-dihydro-6H-purin-6-one**

The results in the table showed that the lengths of some bonds changed due to the presence of the substitute group (CH_3 , OH) The reason is due to the effect of the added group on the original form of the drug ,also the presence of the added group led to a change in the angles, and the reason is that the presence of these groups led to a change in the geometric shape to the most stable form in which the repulsion between the orbitals is at a minimum

Acyclovir		Methylacyclovir		Ganciclovir	
Para. Geo.	Bond length and Angle	Para. Geo.	Bond length and Angle	Para. Geo.	Bond length and Angle
R(1-2)	1.320	R(1-2)	1.319	R(1-2)	1.322
R(1-9)	1.398	R(1-9)	1.401	R(1-9)	1.398
R(2-3)	1.403	R(2-3)	1.404	R(2-3)	1.407
R(2-17)	1.077	R(2-18)	1.077	R(2-19)	1.077
R(3-4)	1.383	R(3-4)	1.384	R(3-4)	1.382
R(3-11)	1.437	R(3-12)	1.436	R(3-11)	1.452
R(4-5)	1.363	R(4-5)	1.357	R(4-5)	1.365



Methylacyclovir

2-amino-9-(((1,3-dihydroxypropan-2-yl)oxy)methyl)-1,9-dihydro-6H-purin-6-one

Chemical Formula :$C_9H_{13}N_5O_4$

255.2306 : Molecular Mas

O N C H

Ganciclovir

Fig.1 . Three-dimensional geometric shape(3D) for the Acyclovir and some its derivatives

Table 1 : Calculated geometric parameters (bond lengths in Angstrom length angles for Acyclovir and some its derivatives

R(4-9)	1.398	R(4-9)	1.394	R(4-9)	1.399
R(5-6)	1.327	R(5-6)	1.331	R(5-6)	1.326
R(6-7)	1.381	R(6-7)	1.386	R(6-7)	1.382
R(6-16)	1.365	R(6-17)	1.366	R(6-18)	1.366
R(7-8)	1.446	R(7-8)	1.463	R(7-8)	1.445
R(7-18)	1.013	R(7-11)	1.470	R(7-20)	1.013
R(8-9)	1.432	R(8-9)	1.427	R(8-9)	1.432
R(8-10)	1.243	R(8-10)	1.246	R(8-10)	1.244
R(11-12)	1.448	R(11-19)	1.090	R(11-12)	1.451
R(11-19)	1.095	R(11-20)	1.096	R(11-21)	1.090
R(11-20)	1.098	R(11-21)	1.096	R(11-22)	1.089
R(12-13)	1.455	R(12-13)	1.449	R(12-14)	1.463
R(13-14)	1.517	R(12-22)	1.096	R(13-14)	1.521
R(13-21)	1.099	R(12-23)	1.098	R(13-17)	1.465
R(13-22)	1.099	R(13-14)	1.455	R(13-23)	1.095
R(14-15)	1.454	R(14-15)	1.517	R(13-24)	1.099
R(14-23)	1.098	R(14-24)	1.099	R(14-15)	1.526
R(14-24)	1.098	R(14-25)	1.099	R(14-25)	1.096
R(15-25)	0.977	R(15-16)	1.454	R(15-16)	1.455
R(16-26)	1.006	R(15-26)	1.098	R(15-26)	1.096
R(16-27)	1.005	R(15-27)	1.098	R(15-27)	1.099
A(2-1-9)	105.1	R(16-28)	0.977	R(16-28)	0.976
A(1-2-3)	112.4	R(17-29)	1.006	R(17-29)	0.977
A(1-2-17)	125.9	R(17-30)	1.003	R(18-30)	1.006
A(1-9-4)	110.3	R(10-19)	2.152	R(18-31)	1.005
A(1-9-8)	130.3	A(2-1-9)	105.0	R(17-21)	2.304
A(3-2-17)	121.7	A(1-2-3)	112.5	A(2-1-9)	105.1
A(2-3-4)	106.2	A(1-2-18)	125.9	A(1-2-3)	112.4
A(2-3-11)	127.4	A(1-9-4)	110.3	A(1-2-19)	126.7
A(4-3-11)	126.1	A(1-9-8)	129.8	A(1-9-4)	110.4
A(3-4-5)	125.8	A(3-2-18)	121.6	A(1-9-8)	130.2
A(3-4-9)	106.0	A(2-3-4)	106.0	A(3-2-19)	120.9
A(3-11-12)	108.4	A(2-3-12)	127.6	A(2-3-4)	106.1
A(3-11-19)	107.9	A(4-3-12)	126.2	A(2-3-11)	127.4
A(3-11-20)	109.6	A(3-4-5)	126.3	A(4-3-11)	126.5
A(5-4-9)	128.2	A(3-4-9)	106.1	A(3-4-5)	126.0
A(4-5-6)	113.5	A(3-12-13)	108.4	A(3-4-9)	106.0
A(4-9-8)	119.4	A(3-12-22)	107.9	A(3-11-12)	113.9
A(5-6-7)	122.8	A(3-12-23)	109.7	A(3-11-21)	108.1
A(5-6-16)	119.1	A(5-4-9)	127.6	A(3-11-22)	108.2
A(7-6-16)	118.1	A(4-5-6)	113.8	A(5-4-9)	128.0
A(6-7-8)	125.9	A(4-9-8)	119.8	A(4-5-6)	113.6
A(6-7-18)	120.8	A(5-6-7)	124.1	A(4-9-8)	119.5

A(6-16-26)	117.5	A(5-6-17)	117.6	A(5-6-7)	122.9
A(6-16-27)	123.2	A(7-6-17)	118.3	A(5-6-18)	119.1
A(8-7-18)	113.3	A(6-7-8)	123.2	A(7-6-18)	118.0
A(7-8-9)	110.2	A(6-7-11)	120.6	A(6-7-8)	125.8
A(7-8-10)	118.8	A(6-17-29)	116.7	A(6-7-20)	120.8
A(9-8-10)	131.0	A(6-17-30)	123.6	A(6-18-30)	117.3
A(12-11-19)	111.0	A(8-7-11)	116.1	A(6-18-31)	123.2
A(12-11-20)	110.0	A(7-8-9)	111.4	A(8-7-20)	113.3
A(11-12-13)	113.6	A(7-8-10)	119.3	A(7-8-9)	110.3
A(19-11-20)	109.8	A(7-11-19)	106.5	A(7-8-10)	118.7
A(12-13-14)	106.4	A(7-11-20)	110.9	A(9-8-10)	131.0
A(12-13-21)	110.9	A(7-11-21)	110.9	A(12-11-21)	110.5
A(12-13-22)	111.0	A(9-8-10)	129.3	A(12-11-22)	104.2
A(14-13-21)	110.1	A(8-10-19)	87.5	A(11-12-14)	117.9
A(14-13-22)	110.0	A(19-11-20)	109.2	A(21-11-22)	112.0
A(13-14-15)	105.6	A(19-11-21)	109.2	A(11-21-17)	118.7
A(13-14-23)	109.6	A(11-19-10)	110.5	A(12-14-13)	113.0
A(13-14-24)	109.6	A(20-11-21)	110.1	A(12-14-15)	103.3
A(21-13-22)	108.4	A(13-12-22)	111.0	A(12-14-25)	110.4
A(15-14-23)	111.8	A(13-12-23)	109.9	A(14-13-17)	107.9
A(15-14-24)	111.8	A(12-13-14)	113.6	A(14-13-23)	108.4
A(14-15-25)	110.5	A(22-12-23)	109.8	A(14-13-24)	109.5
A(23-14-24)	108.4	A(13-14-15)	106.4	A(13-14-15)	112.0
A(26-16-27)	119.4	A(13-14-24)	110.9	A(13-14-25)	108.8
		A(13-14-25)	111.0	A(17-13-23)	111.0
		A(15-14-24)	110.1	A(17-13-24)	110.6
		A(15-14-25)	110.0	A(13-17-29)	110.7
		A(14-15-16)	105.6	A(13-17-21)	96.2
		A(14-15-26)	109.6	A(23-13-24)	109.5
		A(14-15-27)	109.6	A(15-14-25)	109.3
		A(24-14-25)	108.4	A(14-15-16)	107.0
		A(16-15-26)	111.8	A(14-15-26)	108.5
		A(16-15-27)	111.8	A(14-15-27)	109.5
		A(15-16-28)	110.5	A(16-15-26)	111.9
		A(26-15-27)	108.4	A(16-15-27)	111.4
		A(29-17-30)	119.7	A(15-16-28)	110.7
				A(26-15-27)	108.4
				A(29-17-21)	134.3
				A(30-18-31)	119.5

CHARGES AND ELECTRONIC DENSITIES

The Calculated for all charges and electronic density of acyclovir derivatives studied according to the method (DFT, B3LYP/6-31G).The results showed change in the values of the charges and the electronic density of the atoms. O13, O16 and O16 atoms of the

studied compounds have the same electronic density , the reason is that they are not close to the substituted group added so their charge is not affected but electronic density of N16 ,N18 in acyclovir and ganciclovir Almost equal in value, while the electronic density increases in N17 of methylacyclovir due to the presence electron denoting group (CH_3) which increase electronic density in the Ortho and Para sites . At the same time, electronic density of C14 of acyclovir derivatives studied decreases due to the presence of OH (electron – with drawing group)

Table 1 :Calculated charge and electronic density for Acyclovir and some its deravitives

Acyclovir			Methylacyclovir			Ganciclovir		
Atom	Charge	Electronic Density	Atom	Charge	Electronic Density	Atom	Charge	Electronic Density
C1	- 0.385	6.385	N1	-0.384	5.384	N1	-0.389	5.389
C2	0.271	5.729	C2	0.271	3.729	C2	0.242	3.758
N3	-0.672	5.672	N3	-0.674	5.674	N3c	-0.677	5.677
C4	0.472	3.528	C4	0.479	3.521	C4	0.462	3.538
N5	-0.422	5.422	N5	-0.428	5.428	N5	-0.416	5.416
C6	0.699	3.301	C6	0.695	3.305	C6	0.693	3.307
N7	- 0.739	5.739	N7	-0.663	5.663	N7	-0.738	5.738
C8	0.492	5.408	C8	0.505	3.495	C8	0.489	3.511
C9	0.046	5.954	C9	0.040	3.960	C9	0.046	3.954
O10	-0.426	6.426	O10	-0.437	6.437	O10	-0.431	6.431
C11	0.149	3.851	C11	-0.280	4.280	C11	0.129	3.871
C12	0.523	3.477	C12	0.149	3.851	C12	-0.526	4.526
C13	-0.003	4.003	C13	-0.523	4.523	C13	-0.034	4.034
C14	-0.034	4.034	C14	-0.003	4.003	C14	0.107	3.893
O15	-0.620	6.620	C15	- 0.034	4.034	C15	-0.033	4.033
N16	-0.758	5.758	O16	- 0.620	6.620	O16	-0.620	6.620
H17	0.174	0.826	N17	- 0.763	5.763	O17	-0.626	6.626
H18	0.332	0.668	H18	0.172	0.828	N18	-0.759	5.759
H19	0.175	0.825	H19	0.229	0.771	H19	0.197	0.803
H20	0.148	0.852	H20	0.160	0.840	H20	0.329	0.671
H21	0.147	0.853	H21	0.159	0.841	H21	0.186	0.814
H22	0.143	0.857	H22	0.174	0.826	H22	0.184	0.816
H23	0.144	0.856	H23	0.147	0.853	H23	0.174	0.826
H24	0.146	0.854	H24	0.146	0.853	H24	0.135	0.865
H25	0.365	0.653	H25	0.142	0.858	H25	0.169	0.831
H26	0.347	0.653	H26	0.144	0.856	H26	0.153	0.847
H27	0.328	0.672	H27	0.146	0.854	H27	0.139	0.861
			H28	0.365	0.635	H28	0.368	0.632
			H29	0.345	0.655	H29	0.369	0.631
			H30	0.334	0.666	H30	0.347	0.653
						H31	0.326	0.674

The presence of atoms in the compound have non-bonding Increase the non-localization of the electrons, meaning that it increases the resonance and thus increases the stability of the molecule and its effect is less harmful to the human body.

PHYSICAL PROPERTIES

Depending on the density Functional Theory (DFT, B3LYP/6-31G) some of Physical Properties of the molecules studied in this paper . The higher HOMO energy values show the molecules is a good electron donor while the lower value of LUMO energy indicates a weak ability to electron donor and a good electron receiving . The negative E_{HOMO} is equal to the ionization potential (IP) . The molecule have lower HOMO energy indicates more stable than higher HOMO energy . The lower the ionization energy, the less stable the

compound and the greater the reactivity of the compound, which means that its effect on the body increases so Ganciclovir is more stable than other compounds . HOMO – LUMO gap always refers to higher Kinetic stability and lower chemical reactivity, so the Ganciclovir is more stable compare to other molecules studied [25](**table 3) .**

Table 3: Calculated Standard Thermodynamic Function at 298.15K of the Acyclovir and its Derivatives in ev unite

Comp.	E HOMO (ev)	E LUMO (ev)	EΔ (ev)	IP (ev)
Acyclovir	-0.364	-5.714	5.350	0.364
Methyl acyclovir	-0.302	-5.617	5.314	0.302
Ganciclovir	-0.274	-5.634	5.360	0.274

Thermodynamics functions

The results shown in (**Table 4**) showed that the thermodynamic functions of Ganciclovir is higher than the rest of the compounds that were studied , This is due to the effect of the group OH on the geometry of the molecule, which may lead to an increase in the stability of the molecule **(Table 4)**.

Table 4: Calculated Standard Thermodynamic Function at 298.15K of the Acyclovir and its Derivatives in KJ/mol

Comp.	E^0 KJ/mol	H^0 KJ/mol	G^0 KJ/mol	A^0 KJ/mol	S^0 KJ/mol.K	CV KJ/mol.K
Acyclovir	582.560	585.038	431.530	429.052	0.514	0.224
Methyl acyclovir	658.960	661.438	500.138	497.660	0.541	0.245
Ganciclovir	673.400	675.878	512.492	510.014	0.548	0.262

AIM OF RESEARCH

Acyclovir is an antiviral drug used as a treatment for herpes simplex virus, herpes zoster virus, and cytomegalovirus acyclovir is also used as a preventive treatment for recurrent episodes of infection with these viruses, as it helps reduce the number of these attacks in the future. So the aim of this paper

1- To recognize the theoretical results prior to clinical and laboratory studies.
2- To know the thermodynamic and physical properties of Acyclovir and its derivatives to reach a balanced geometric shape that is more stable and less sensitive than using it as a medicine.

RECOMMENDATIONS

1-In the future, studies should focus on Acyclovir and its derivatives that are more effective against viruses and have less side effects on the body.
2-Future studies should focus on Acyclovir and its derivatives efficacy against cancer.

SUMMARY

In summary, acyclovir is sufficiently potent and non-toxic to use in any severe or life threatening condition caused by herpes simplex viruses I and II and varicella zoster virus. less severe and recurrent disease it seems sensible to limit its use, as indiscriminate prescribing may lead to increasing resistance and loss of efficacy of a lifesaving drug Adding some compensating groups to acyclovir may change the behavior of viruses and we may get better results in treating infections , And to reduce the side effects of this drug.

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