

Supporting Information

Synthesis and Biological Evaluation of β -lactams as Potent Antidiabetic Agents

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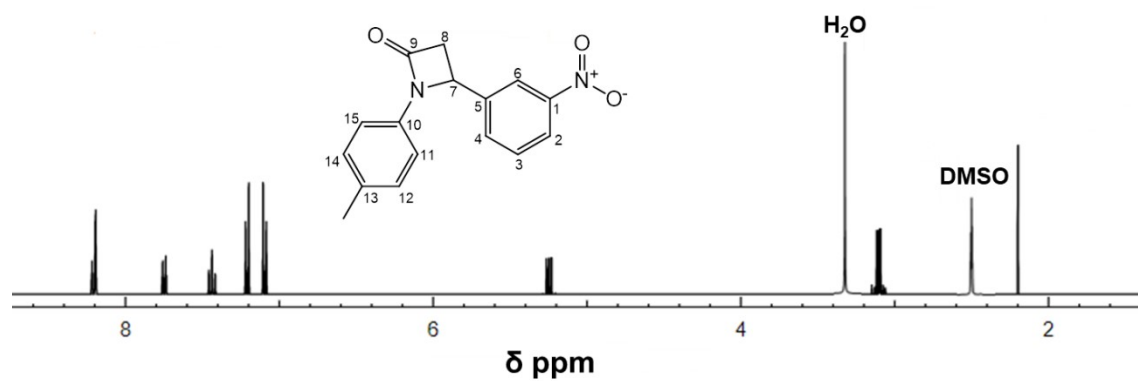


Figure S1. ¹H NMR spectrum of compound **B8** recorded in DMSO-*d*₆.

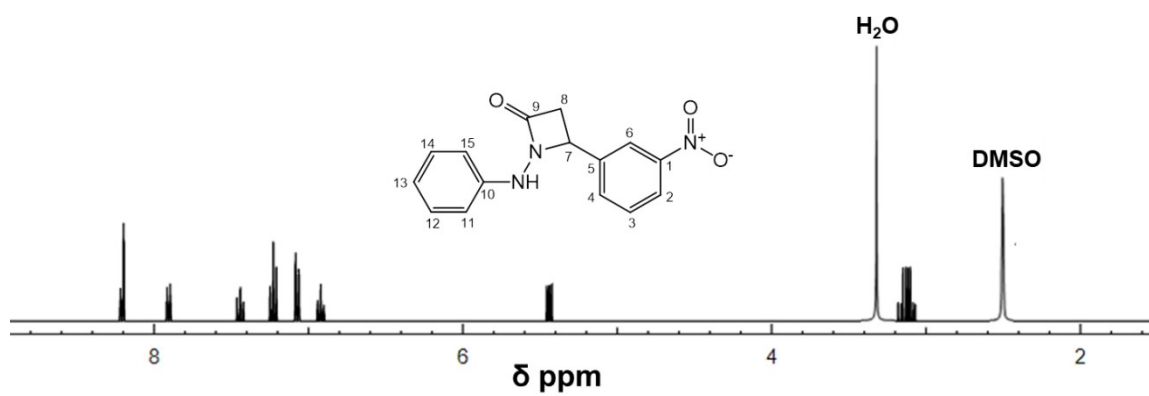


Figure S2. ¹H NMR spectrum of compound **B9** recorded in DMSO-*d*₆.

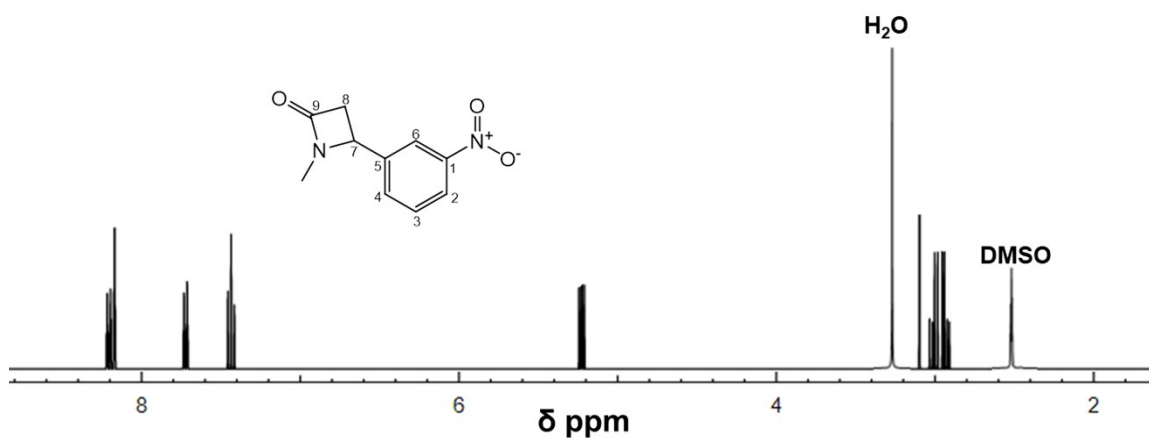


Figure S3. ¹H NMR spectrum of compound **B10** recorded in DMSO-*d*₆.

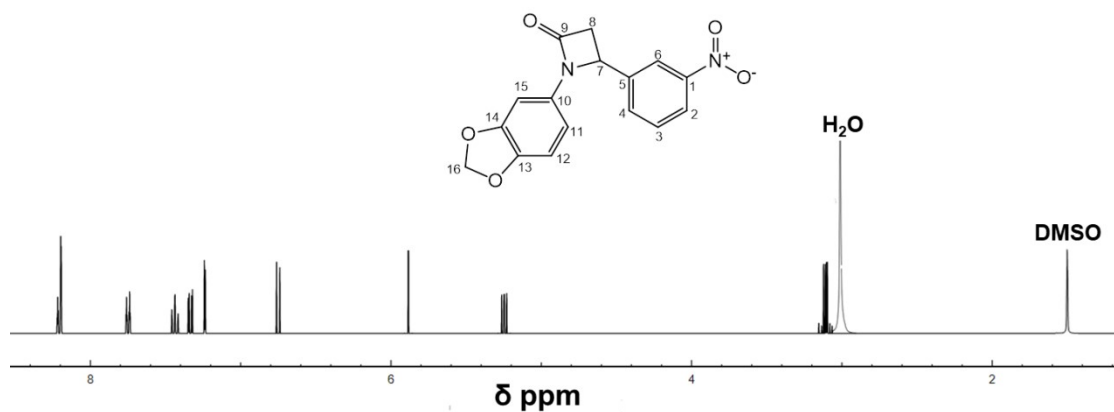


Figure S4. ¹H NMR spectrum of compound **B11** recorded in DMSO-*d*₆.

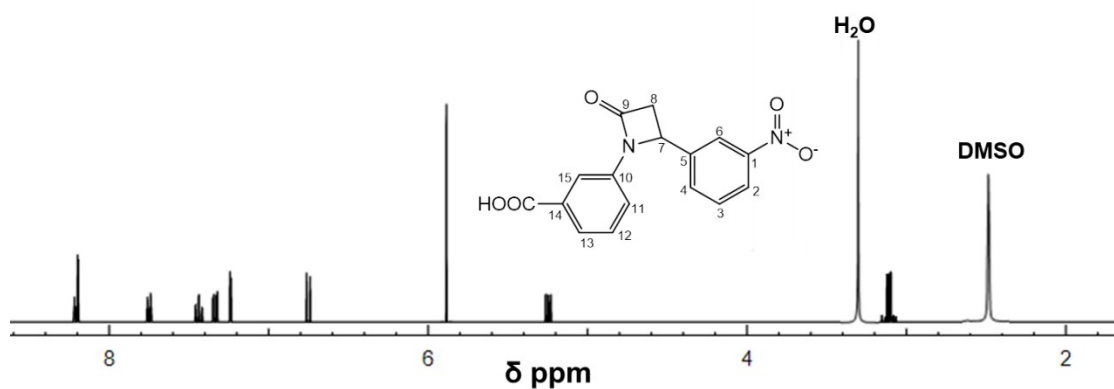


Figure S5. ¹H NMR spectrum of compound **B12** recorded in DMSO-*d*₆.

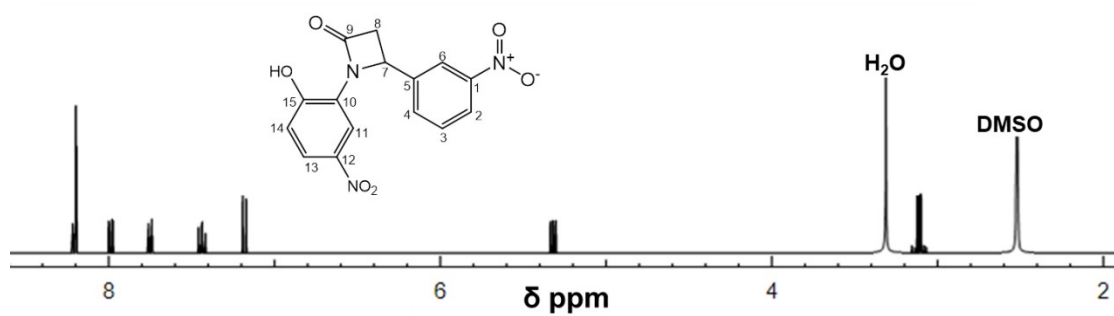


Figure S6. ¹H NMR spectrum of compound **B13** recorded in DMSO-*d*₆.

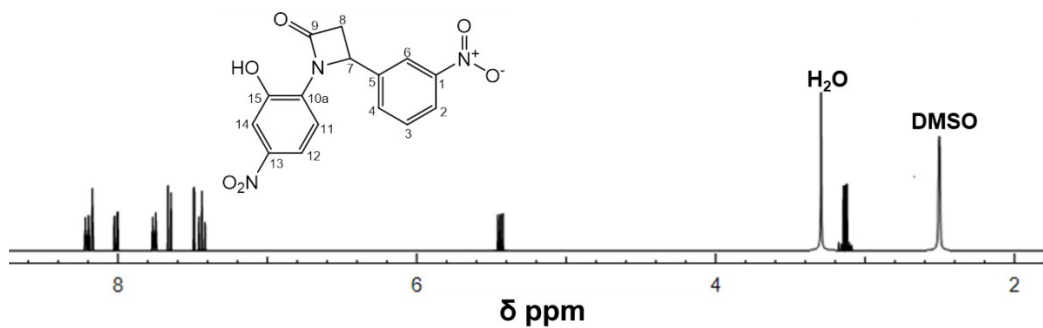


Figure S7. ^1H NMR spectrum of compound **B14** recorded in $\text{DMSO-}d_6$.

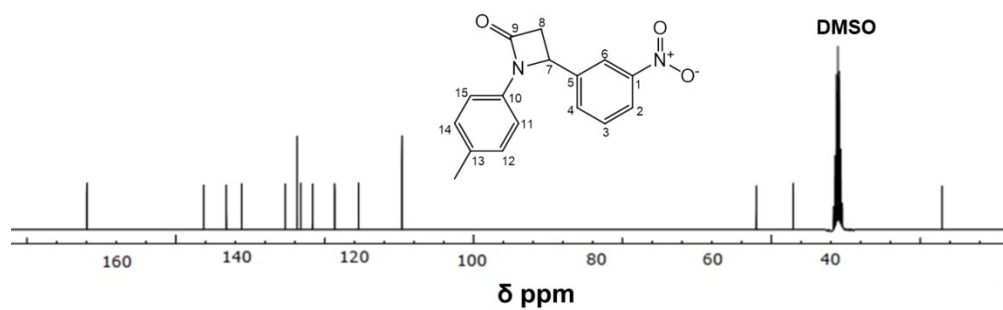


Figure S8. $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of compound **B8** recorded in $\text{DMSO-}d_6$.

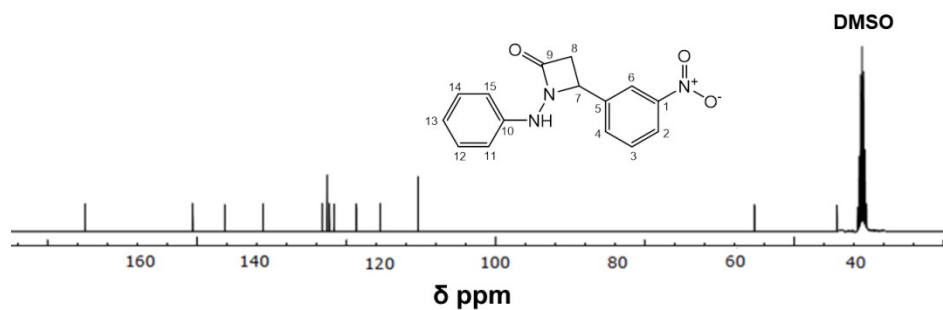


Figure S9. $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of compound **B9** recorded in $\text{DMSO-}d_6$.

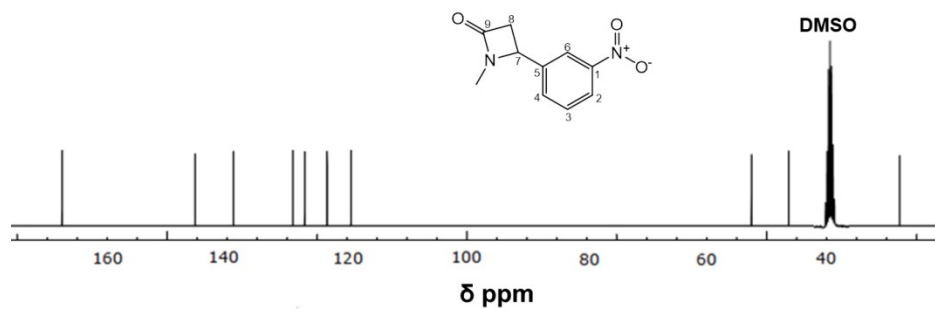


Figure S10. $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of compound **B10** recorded in $\text{DMSO-}d_6$.

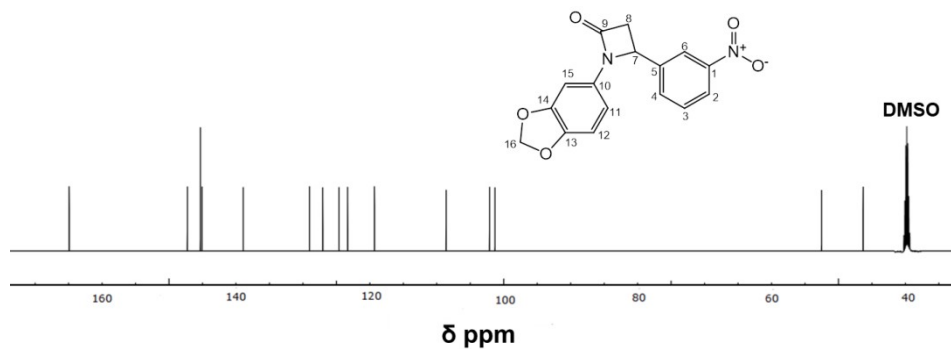


Figure S11. $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of compound **B11** recorded in $\text{DMSO-}d_6$.

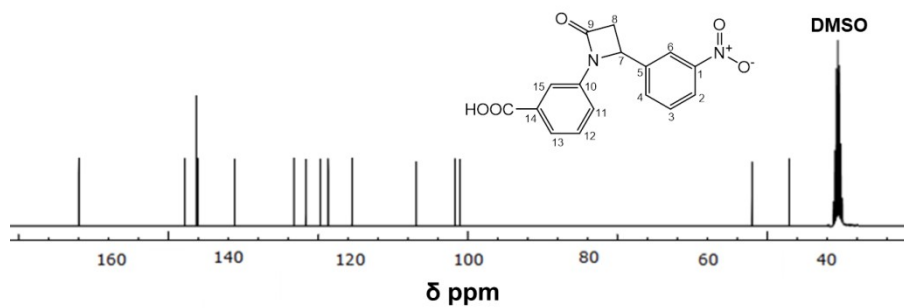


Figure S12. $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of compound **B12** recorded in $\text{DMSO-}d_6$.

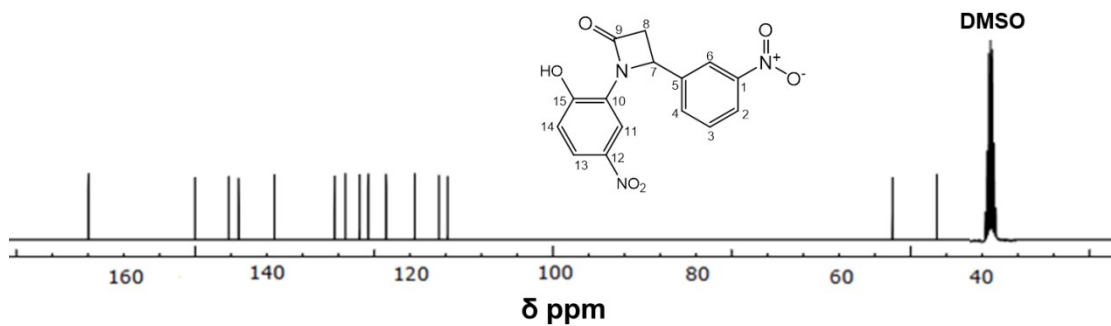


Figure S13. $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of compound **B13** recorded in $\text{DMSO-}d_6$.

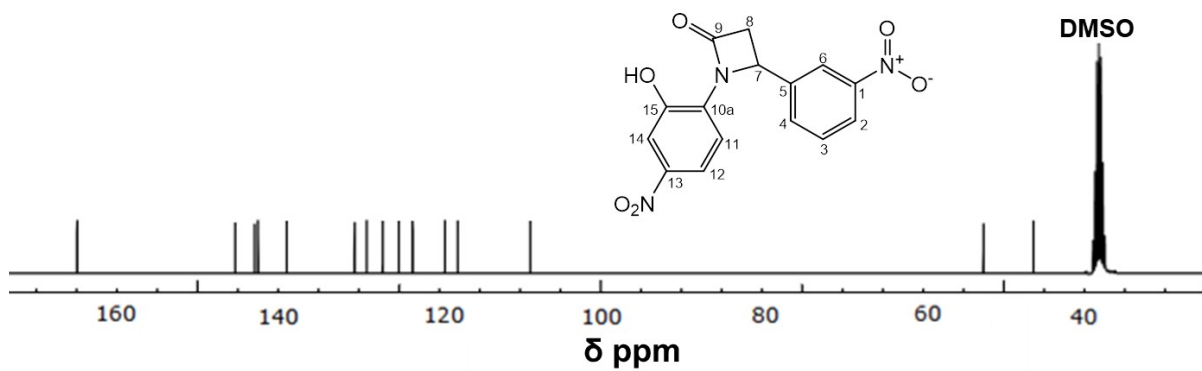


Figure S14. $^{13}\text{C}\{^1\text{H}\}$ NMR spectrum of compound **B14** recorded in $\text{DMSO-}d_6$.

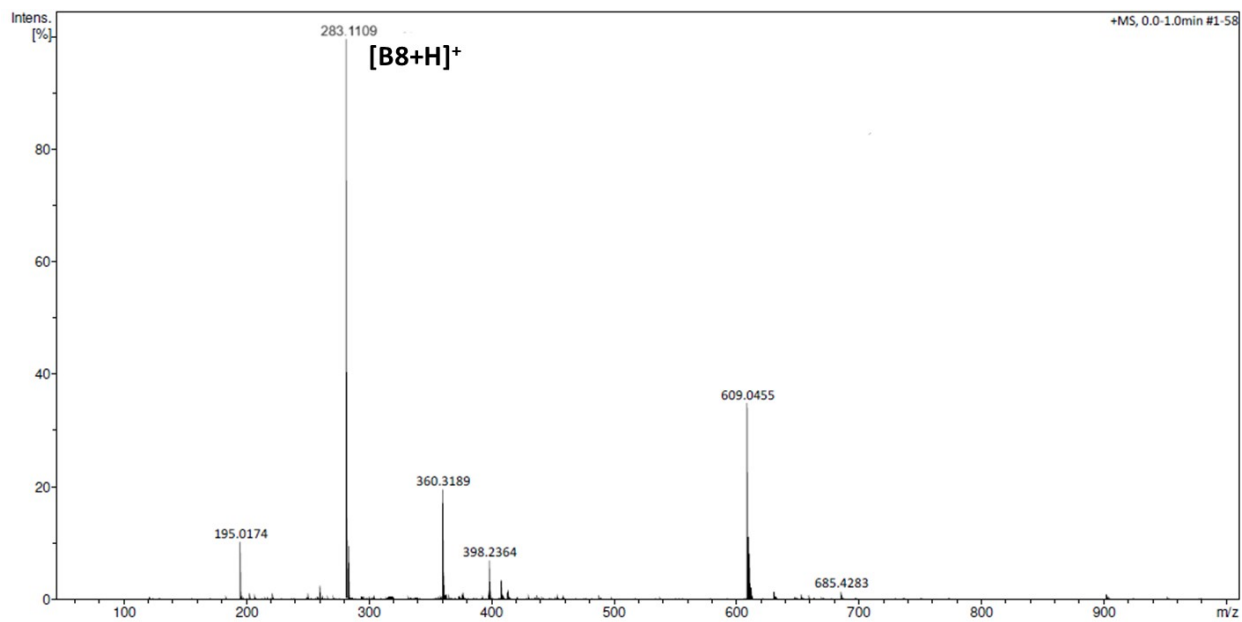


Figure S15. ESI-mass spectrum of compound **B8**.

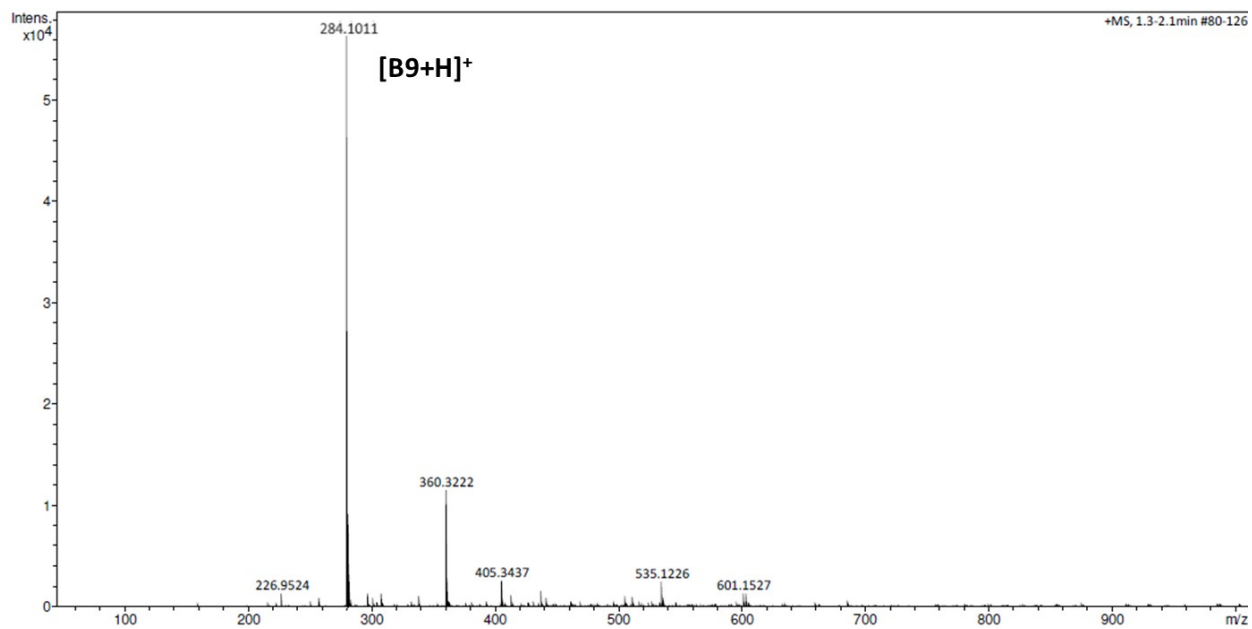


Figure S16. ESI-mass spectrum of compound **B9**.

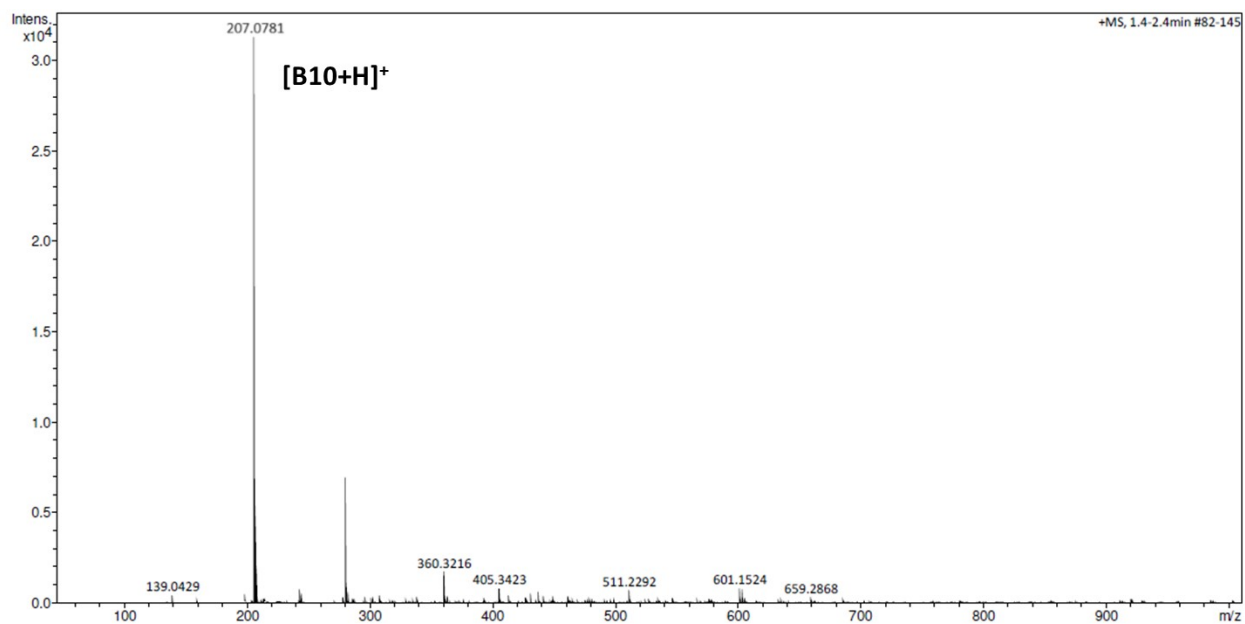


Figure S17. ESI-mass spectrum of compound B10.

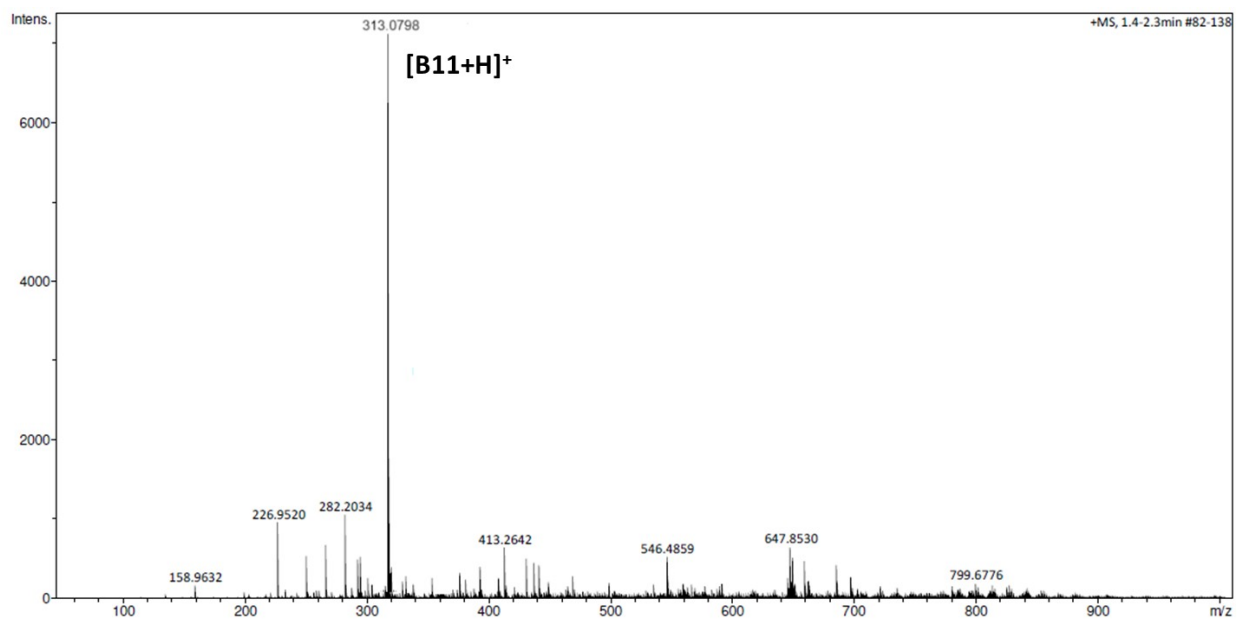


Figure S18. ESI-mass spectrum of compound B11.

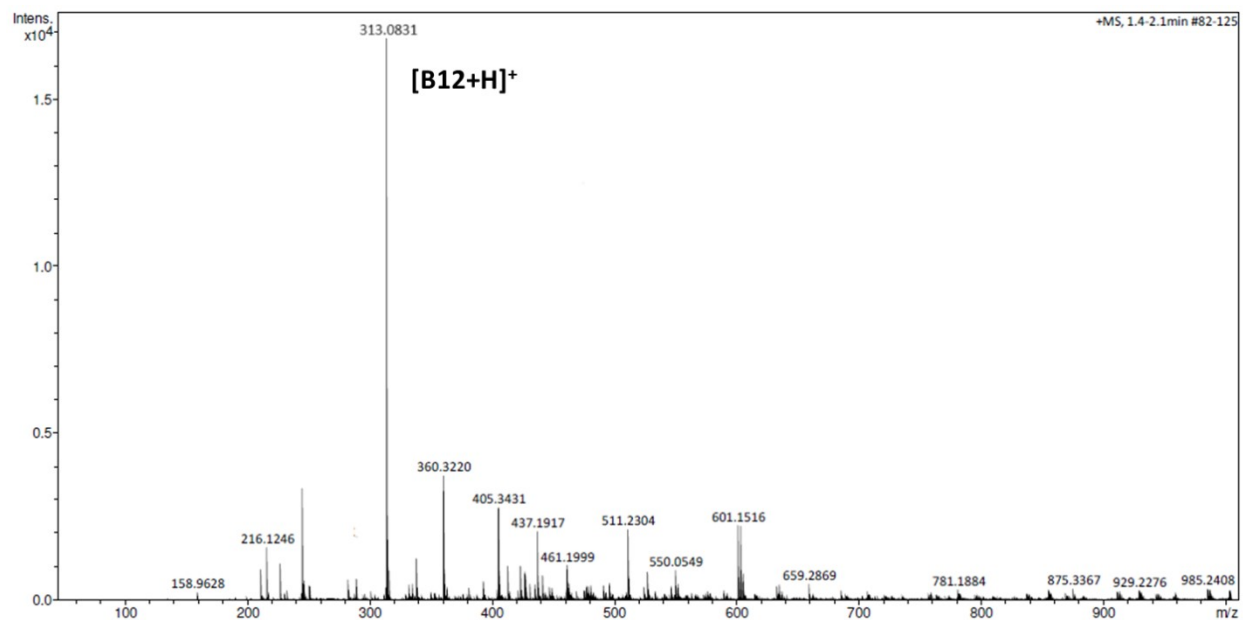


Figure S19. ESI-mass spectrum of compound B12.

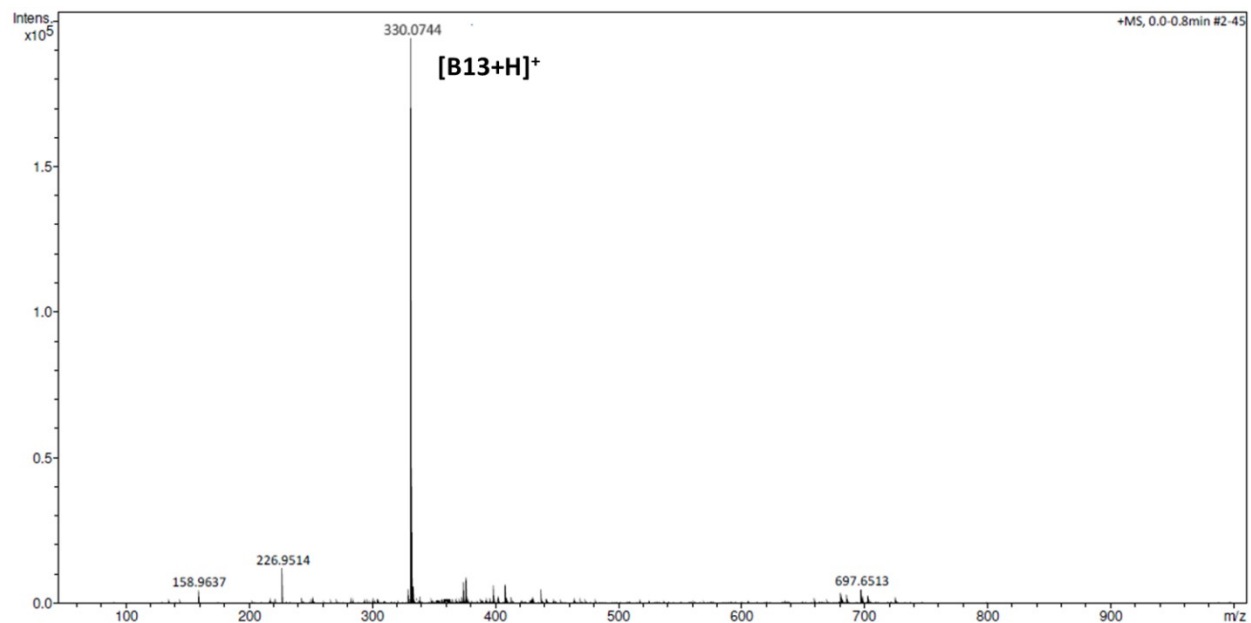


Figure S20. ESI-mass spectrum of compound B13.

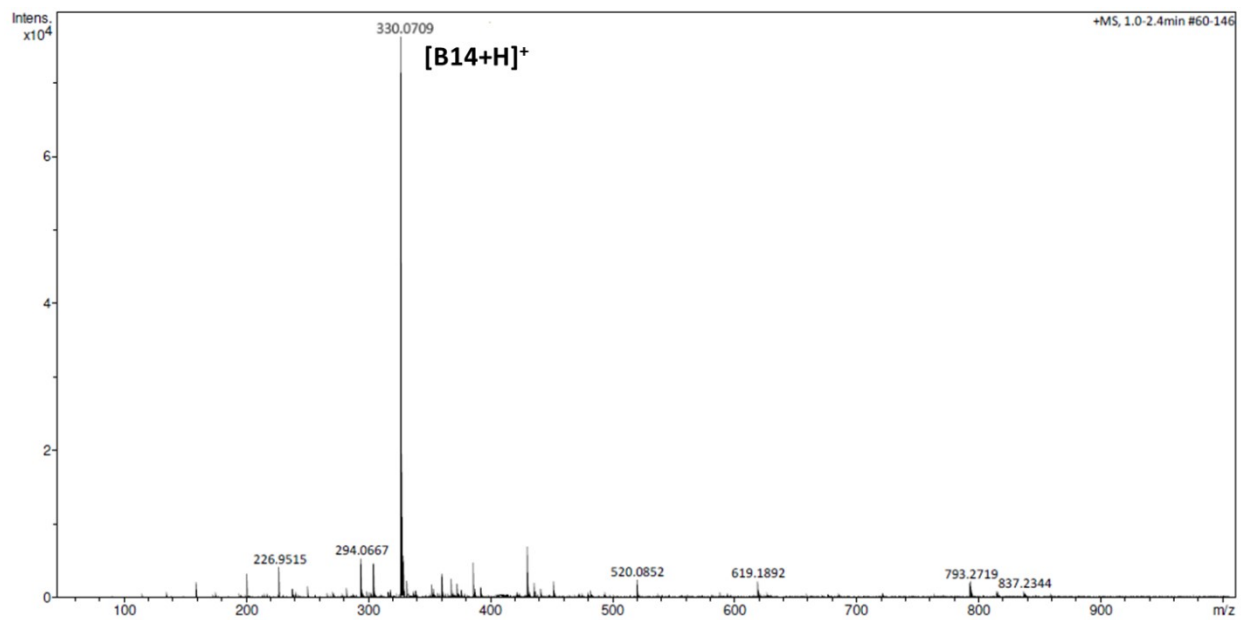


Figure S21. ESI-mass spectrum of compound **B14**.

Table S1: Effect of B8 on blood glucose level (mg/dL) in diabetic rabbits group–A

Exp. Rabbits	Fasting 24 h	*Induced 72 h	Dose of B8 (mg)	Decrease in blood glucose level				Average Decrease	**% Sig.
				3h	6h	12h	24h		
R ₁	136	241	5	230	202	200	167	199.75	17.11
R ₂	130	243		223	200	195	177	198.75	18.20
R ₃	136	245		216	197	190	157	190.00	22.44
R ₄	138	243		228	191	185	182	196.50	19.13
R ₅	130	240		218	195	180	152	186.25	22.39
Average	134	242		223	197	190	167	194.25	19.73
R ₁	136	246	10	215	191	184	170	190.00	22.76
R ₂	130	242		205	180	186	160	182.75	24.48
R ₃	136	260		220	183	190	150	185.75	28.55
R ₄	138	246		200	175	187	165	181.75	26.11
R ₅	130	251		210	186	188	155	184.75	26.39
Average	134	249		210	183	190	160	185.75	25.40
R ₁	136	253	15	244	220	182	158	201.00	20.55
R ₂	130	254		238	225	149	148	190.00	25.19
R ₃	136	253		234	200	170	173	194.25	23.22
R ₄	138	252		230	220	149	148	186.75	25.89
R ₅	130	263		224	208	160	143	183.75	30.13
Average	134	255		234	215	162	158	192.25	24.60
R ₁	136	243	20	232	195	180	154	190.25	21.70
R ₂	130	244		216	203	220	150	197.25	19.15
R ₃	136	243		222	197	215	159	198.25	18.41
R ₄	138	250		226	204	185	150	191.25	23.50
R ₅	130	240		220	203	200	172	198.75	17.18
Average	134	244		222	199	180	157	189.50	22.33
R ₁	136	202	25	160	156	134	130	145.00	28.21
R ₂	130	194		172	126	154	115	141.75	26.93
R ₃	136	200		120	161	114	145	135.00	32.50
R ₄	138	196		160	121	119	120	130.00	33.67
R ₅	130	198		168	141	149	140	149.50	24.49
Average	134	198		166	141	134	130	142.75	27.90

*Induced= Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose.

Table S2: Average effect of B8 on blood glucose level (mg/dL) in diabetic rabbits group–A

Fasting 24 h	*Induced 72 h	Conc. B8 (mg)	Decrease in blood glucose level				Average Decrease	**%Sig.
			3h	6h	12h	24h		
134	242	5	223	197	190	167	194.25	19.73
134	249	10	210	183	190	160	185.75	25.40
134	255	15	234	215	162	158	192.25	24.60
134	244	20	222	199	180	157	189.50	22.33
134	198	25	166	141	134	130	142.75	27.90
131	198	***Std	180	177	173	169	174.75	11.74

*Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose, ***Std= Glibenclamide

Table S3: Effect of B9 on blood glucose level (mg/dL) in diabetic rabbits group-B

Exp. Rabbits	Fasting 24 h	*Induced 72 h	Dose of B9 (mg)	Decrease in blood glucose level				Average Decrease	**% Sig.
				3h	6h	12h	24h		
R ₁	151	200	5	190	168	160	155	168.25	15.87
R ₂	141	220		170	180	165	160	168.75	23.29
R ₃	161	225		190	156	150	150	161.50	28.22
R ₄	136	205		170	175	170	160	168.75	17.68
R ₅	166	200		180	158	155	150	160.75	19.62
Average	151	210		180	168	160	155	165.75	21.07
R ₁	151	190	10	172	168	158	143	160.25	15.65
R ₂	141	200		178	171	167	144	165.00	17.50
R ₃	161	210		166	165	155	142	157.00	25.23
R ₄	136	205		180	176	150	146	163.00	20.48
R ₅	166	195		164	160	160	140	156.00	20.00
Average	151	200		172	168	154	143	159.25	20.37
R ₁	151	200	15	180	170	150	140	160.00	20.00
R ₂	141	215		165	175	140	135	153.75	28.48
R ₃	161	205		180	165	160	150	163.75	20.12
R ₄	136	210		162	180	145	140	156.75	25.35
R ₅	166	200		170	160	155	135	155.00	22.50
Average	151	206		170	160	150	140	155.00	24.75
R ₁	151	198	20	170	159	149	130	152.00	23.23
R ₂	141	182		159	160	154	135	152.00	16.48
R ₃	161	200		185	158	144	140	156.75	21.62
R ₄	136	181		164	158	153	137	153.00	15.46
R ₅	166	201		180	160	145	133	154.50	23.13
Average	151	192		172	159	149	135	153.75	19.92
R ₁	151	198	25	171	170	150	144	158.75	19.82
R ₂	141	194		159	162	138	138	149.25	23.06
R ₃	161	202		180	170	155	152	164.25	18.68
R ₄	136	200		165	154	133	131	145.75	27.12
R ₅	166	196		180	162	144	140	156.50	20.15
Average	151	198		171	162	144	141	154.50	21.96

*Induced= Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose.

Table S4: Average effect of B9 on blood glucose level (mg/dL) in diabetic rabbits group-B

Fasting 24 h	*Induced 72 h	Conc.B8 (mg)	Decrease in blood glucose level				Average Decrease	**%Sig.
			3h	6h	12h	24h		
151	210	5	180	168	160	155	165.75	21.07
151	200	10	172	168	154	143	159.25	20.37
151	206	15	170	160	150	140	155.00	24.75
151	192	20	172	159	149	135	153.75	19.92
151	198	25	171	162	144	141	154.50	21.96
131	198	***Std	180	177	173	169	174.75	11.74

*Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose, ***Std= Glibenclamide

Table S5: Effect of B10 on blood glucose level (mg/dL) in diabetic rabbits group–C

Exp. Rabbits	Fasting 24 h	*Induced 72 h	Dose of B10 (mg)	Decrease in blood glucose level				Average Decrease	**% Sig.
				3h	6h	12h	24h		
R ₁	120	194	5	192	177	168	167	176.00	9.28
R ₂	126	206		202	187	170	169	182.00	11.65
R ₃	115	195		192	172	168	167	174.75	10.38
R ₄	131	203		197	192	170	170	182.25	10.22
R ₅	123	202		187	182	169	167	176.25	12.75
Average	123	200		192	182	173	168	178.75	10.63
R ₁	120	180	10	175	168	160	130	158.25	12.08
R ₂	126	190		185	178	176	133	168.00	11.58
R ₃	115	175		169	163	161	127	155.00	11.43
R ₄	131	196		191	183	178	134	171.50	12.50
R ₅	123	184		180	173	168	126	161.75	12.29
Average	123	185		180	173	169	130	163.00	11.90
R ₁	120	197	15	170	174	168	160	168.00	14.72
R ₂	126	207		180	154	150	150	158.50	23.43
R ₃	115	212		165	184	175	175	174.75	17.57
R ₄	131	202		185	146	142	140	153.25	24.13
R ₅	123	197		175	162	150	150	159.25	19.16
Average	123	203		175	164	157	155	162.75	19.82
R ₁	120	200	20	163	150	147	147	151.75	24.13
R ₂	126	210		173	165	154	154	161.50	23.10
R ₃	115	195		158	155	149	145	151.75	22.18
R ₄	131	216		178	168	153	152	162.75	24.65
R ₅	123	204		168	162	147	147	156.00	23.53
Average	123	205		168	160	150	149	156.75	23.54
R ₁	120	195	25	167	149	140	140	149.00	23.58
R ₂	126	196		177	169	164	142	163.00	16.83
R ₃	115	201		162	144	142	140	147.00	26.86
R ₄	131	195		182	163	143	140	157.00	19.48
R ₅	123	196		172	155	144	138	152.25	22.32
Average	123	196		172	154	143	140	152.25	23.32

*Induced= Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose.

Table S6: Average effect of B10 on blood glucose level (mg/dL) in diabetic rabbits group–C

Fasting 24 h	*Induced 72 h	Conc.B10 (mg)	Decrease in blood glucose level				Average Decrease	**%Sig.
			3h	6h	12h	24h		
123	200	5	192	182	173	168	178.75	10.63
123	185	10	180	173	169	130	163.00	11.90
123	203	15	175	164	157	155	162.75	19.82
123	205	20	168	160	150	149	156.75	23.54
123	196	25	172	154	143	140	152.25	23.32
131	198	***Std	180	177	173	169	174.75	11.74

*Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose, ***Std= Glibenclamide

Table S7: Effect of B11 on blood glucose level (mg/dL) in diabetic rabbits group–D

Exp. Rabbits	Fasting 24 h	*Induced 72 h	Dose of B11 (mg)	Decrease in blood glucose level				Average Decrease	**% Sig.
				3h	6h	12h	24h		
R ₁	125	180	5	178	175	167	158	169.50	5.83
R ₂	139	210		198	182	174	166	180.00	14.28
R ₃	121	180		168	162	160	159	162.25	9.86
R ₄	130	185		183	167	165	157	168.00	9.18
R ₅	120	195		193	174	169	150	171.50	12.05
Average	127	190		183	172	167	158	170.00	10.52
R ₁	125	210	10	187	176	165	164	173.00	17.61
R ₂	139	200		172	166	160	160	164.50	17.75
R ₃	121	220		202	186	170	165	180.75	17.84
R ₄	130	215		177	161	156	155	162.25	24.53
R ₅	120	205		197	191	174	171	183.25	10.60
Average	127	210		187	176	165	163	172.75	17.73
R ₁	125	260	15	237	218	207	196	214.50	17.50
R ₂	139	240		222	208	197	181	202.00	15.83
R ₃	121	270		252	228	217	211	227.00	15.92
R ₄	130	235		229	203	192	186	202.50	13.82
R ₅	120	245		245	233	222	206	226.50	7.55
Average	127	250		237	218	207	196	214.50	14.20
R ₁	125	215	20	213	172	163	154	175.50	18.37
R ₂	139	250		223	177	164	155	179.75	28.10
R ₃	121	220		203	197	162	153	178.75	18.75
R ₄	130	240		228	202	171	158	189.75	20.93
R ₅	120	225		198	187	155	150	172.50	23.33
Average	127	230		213	187	163	154	179.25	22.06
R ₁	125	240	25	236	196	154	154	185.00	22.91
R ₂	139	230		210	181	163	163	179.25	22.06
R ₃	121	250		233	211	183	169	199.00	20.40
R ₄	130	245		213	186	178	164	185.25	24.38
R ₅	120	235		223	206	168	160	189.25	19.46
Average	127	240		223	196	173	162	188.50	21.45

*Induced= Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose.

Table S8: Average effect of B11 on blood glucose level (mg/dL) in diabetic rabbits group–D

Fasting 24 h	*Induced 72 h	Conc.B11 (mg)	Decrease in blood glucose level				Average Decrease	**%Sig.
			3h	6h	12h	24h		
125	190	5	183	172	167	158	170.00	10.52
125	210	10	187	176	165	163	172.75	17.73
125	250	15	237	218	207	196	214.50	14.20
125	230	20	213	187	163	154	179.25	22.06
125	240	25	223	196	173	162	188.50	21.45
131	198	***Std	180	177	173	169	174.75	11.74

*Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose, ***Std= Glibenclamide

Table S9: Effect of B12 on blood glucose level (mg/dL) in diabetic rabbits group–E

Exp. Rabbits	Fasting 24 h	*Induced 72 h	Dose of B12 (mg)	Decrease in blood glucose level				Average Decrease	**% Sig.
				3h	6h	12h	24h		
R ₁	138	192	5	185	163	161	161	167.50	12.76
R ₂	145	197		183	168	163	153	166.75	15.35
R ₃	137	205		187	162	156	155	165.00	19.51
R ₄	145	201		190	172	162	158	170.50	15.17
R ₅	135	195		180	170	158	159	166.75	14.48
Average	140	198		195	167	160	157	169.75	14.26
R ₁	138	206	10	185	178	162	126	162.75	21.00
R ₂	145	196		190	168	160	133	162.75	16.96
R ₃	137	198		196	160	158	126	160.00	19.19
R ₄	145	205		188	172	166	136	165.50	19.26
R ₅	135	195		186	165	164	129	161.00	17.43
Average	140	200		190	170	162	130	163.00	18.50
R ₁	138	235	15	228	158	148	145	169.75	27.77
R ₂	145	237		224	164	147	141	169.00	28.69
R ₃	137	233		230	157	146	137	167.50	28.11
R ₄	145	230		218	165	155	137	168.75	26.63
R ₅	135	240		220	160	154	142	169.00	29.58
Average	140	235		224	161	150	140	168.75	28.19
R ₁	138	244	20	207	171	161	136	168.75	30.84
R ₂	145	246		197	171	165	138	167.75	31.80
R ₃	137	242		196	168	150	144	164.50	32.02
R ₄	145	248		205	165	166	140	169.00	31.85
R ₅	135	240		195	175	163	142	168.75	29.69
Average	140	244		200	170	165	140	168.75	30.84
R ₁	138	252	25	195	166	152	140	163.25	35.21
R ₂	145	263		207	167	158	144	169.00	35.74
R ₃	137	258		198	174	150	138	165.00	36.04
R ₄	145	252		206	175	152	142	168.75	33.03
R ₅	135	250		194	172	158	136	165.00	34.00
Average	140	255		200	170	154	140	166.00	34.90

*Induced= Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose.

Table S10: Average effect of B12 on blood glucose level (mg/dL) in diabetic rabbits group–E

Fasting 24 h	*Induced 72 h	Conc. B12 (mg)	Decrease in blood glucose level				Average Decrease	**%Sig.
			3h	6h	12h	24h		
140	198	5	195	167	160	157	169.75	14.26
140	200	10	190	170	162	130	163.00	18.50
140	235	15	224	161	150	140	168.75	28.19
140	244	20	200	170	165	140	168.75	30.84
140	255	25	200	170	154	140	166.00	34.90
131	198	***Std	180	177	173	169	174.75	11.74

*Dithizone (3 mg) as diabetes inducer, ***% significance. = Average decrease/induced blood glucose, ***Std= Glibenclamide

Table S11: Effect of B13 on blood glucose level (mg/dL) in diabetic rabbits group–F

Exp. Rabbits	Fasting 24 h	*Induced 72 h	Dose of B13 (mg)	Decrease in blood glucose level				Average Decrease	***% Sig.
				3h	6h	12h	24h		
R ₁	130	220	5	213	203	195	164	193.75	11.93
R ₂	127	219		212	202	186	166	191.50	12.55
R ₃	133	222		211	200	202	167	195.00	12.16
R ₄	131	224		210	201	201	168	195.00	12.94
R ₅	134	215		204	194	201	160	189.75	11.74
Average	131	220		207	200	197	165	192.25	12.61
R ₁	130	196	10	180	170	163	167	170.00	13.26
R ₂	127	194		182	172	162	165	170.25	12.24
R ₃	133	198		193	173	173	170	177.25	10.47
R ₄	131	195		179	170	170	164	170.75	12.43
R ₅	134	192		186	165	165	172	172.00	10.41
Average	131	195		180	170	164	166	170.00	12.82
R ₁	130	220	15	170	167	160	150	161.75	26.47
R ₂	127	223		172	173	162	149	164.00	26.45
R ₃	133	222		173	164	163	151	162.75	26.68
R ₄	131	224		170	161	166	153	162.50	27.45
R ₅	134	221		165	160	159	152	159.00	28.05
Average	131	222		170	165	162	151	162.00	27.02
R ₁	130	205	20	163	160	160	142	156.25	23.78
R ₂	127	204		162	163	163	143	157.75	22.67
R ₃	133	213		171	164	163	144	160.50	24.64
R ₄	131	202		163	156	156	146	155.25	23.14
R ₅	134	201		161	157	154	145	154.25	23.25
Average	131	205		164	160	159	144	156.75	23.53
R ₁	130	200	25	167	152	139	130	147.00	26.50
R ₂	127	201		165	143	136	131	143.75	28.48
R ₃	133	202		170	149	133	132	146.00	27.72
R ₄	131	200		164	150	134	129	144.25	27.87
R ₅	134	202		172	151	143	133	149.75	25.86
Average	131	201		167	149	137	131	146.00	27.36

*Induced= Dithizone (3 mg) as diabetes inducer, ***% significance. = Average decrease/induced blood glucose.

Table S12: Average effect of B13 on blood glucose level (mg/dL) in diabetic rabbits group–F

Fasting 24 h	*Induced 72 h	Conc.B-13 (mg)	Decrease in blood glucose level				Average Decrease	***% Sig.
			3h	6h	12h	24h		
131	220	5	207	200	197	165	192.25	12.61
131	195	10	180	170	164	166	170.00	12.82
131	222	15	170	165	162	151	162.00	27.02
131	205	20	164	160	159	144	156.75	23.53
131	201	25	167	149	137	131	146.00	27.36
131	198	***Std	180	177	173	169	174.75	11.74

*Dithizone (3 mg) as diabetes inducer, ***% significance. = Average decrease/induced blood glucose, ***Std= Glibenclamide

Table S13: Effect of B14 on blood glucose level (mg/dL) in diabetic rabbits group–G

Exp. Rabbits	Fasting 24 h	*Induced 72 h	Dose of B14 (mg)	Decrease in blood glucose level				Average Decrease	**% Sig.
				3h	6h	12h	24h		
R ₁	117	192	5	172	170	152	150	161.00	16.14
R ₂	127	199		165	168	158	155	161.50	18.84
R ₃	120	189		179	173	159	149	165.00	12.69
R ₄	124	199		164	171	150	146	157.75	20.72
R ₅	122	185		180	168	156	150	163.50	11.62
Average	122	192		172	170	155	150	161.75	15.75
R ₁	117	200	10	171	167	161	150	162.25	18.87
R ₂	127	205		175	171	159	153	164.50	19.75
R ₃	120	195		179	175	162	147	165.75	15.00
R ₄	124	205		178	174	165	159	169.00	17.56
R ₅	122	195		172	170	153	144	159.75	18.07
Average	122	200		175	171	160	150	164.00	18.00
R ₁	117	220	15	190	175	145	145	163.75	25.56
R ₂	127	225		185	174	155	147	165.25	26.55
R ₃	120	215		190	178	154	143	166.25	22.67
R ₄	124	230		180	175	147	144	161.50	29.78
R ₅	122	210		175	173	149	146	160.75	23.45
Average	122	220		185	175	150	145	163.75	25.56
R ₁	117	250	20	172	160	152	148	158.00	36.80
R ₂	127	235		175	168	155	145	160.75	31.59
R ₃	120	230		169	165	148	151	158.25	31.19
R ₄	124	260		180	169	154	150	163.25	37.21
R ₅	122	245		164	162	146	146	154.50	36.93
Average	122	244		172	162	150	148	158.00	35.24
R ₁	117	253	25	180	169	145	140	158.50	37.35
R ₂	127	256		175	161	155	137	157.00	38.67
R ₃	120	263		185	170	150	142	161.75	38.49
R ₄	124	250		165	161	135	142	150.75	39.70
R ₅	122	243		195	164	140	139	159.50	34.36
Average	122	253		180	165	145	140	157.50	37.74

*Induced= Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose.

Table S14: Average effect of B14 on blood glucose level (mg/dL) in diabetic rabbits group–G

Fasting 24 h	*Induced 72 h	Conc.B14 (mg)	Decrease in blood glucose level				Average Decrease	**%Sig.
			3h	6h	12h	24h		
122	192	5	172	170	155	150	161.75	15.75
122	200	10	175	171	160	150	164.00	18.00
122	220	15	185	175	150	145	163.75	25.56
122	244	20	172	162	150	148	158.00	35.24
122	253	25	180	165	145	140	157.50	37.74
131	198	***Std	180	177	173	169	174.75	11.74

*Dithizone (3 mg) as diabetes inducer, **% significance. = Average decrease/induced blood glucose, ***Std= Glibenclamide

Table S15: Effects of β -lactams (**B8-B14**) on alanine aminotransferase levels (ALT) in rabbits with dithizone-induced diabetes at a dosage of 5 mg/kg.

β -lactams (Study Groups)	Normal ALT Level (U/U) Pre-induced Diabetes	ALT Level (U/U) 72 h Post-induced Diabetes	Time after administration		
			24 h	48 h	72 h
B8 (Group A)	30.0 \pm 0.11	102.1 \pm 2.45	29.5 \pm 0.41	29.5 \pm 0.60	29.1 \pm 1.05
	63.8%	100%	71.1%	71.1%	71.4%
B9 (Group B)	31.2 \pm 0.23	106.1 \pm 1.95	28.2 \pm 1.01	27.4 \pm 0.55	27.2 \pm 1.95
	63.8%	100%	73.4%	74.1%	74.3%
B10 (Group C)	29.8 \pm 0.20	85.9 \pm 1.25	37.4 \pm 0.77	37.1 \pm 0.31	37.1 \pm 1.81
	65.3%	100%	56.4%	56.8%	56.8%
B11 (Group D)	29.1 \pm 0.21	81.5 \pm 0.95	35.9 \pm 2.45	35.5 \pm 1.41	35.4 \pm 0.72
	64.2%	100	55.9%	56.4%	56.5%
B12 (Group E)	34.1 \pm 1.09	95.2 \pm 3.33	40.2 \pm 0.30	35.5 \pm 1.69	36.2 \pm 1.42
	64.1%	100	63.0%	62.7%	61.9%
B13 (Group F)	32.1 \pm 0.17	97.5 \pm 3.45	31.5 \pm 2.63	31.2 \pm 0.13	31.3 \pm 0.77
	67.0%	100	67.6%	68.0%	67.8%
B14 (Group G)	33.8 \pm 1.15	101.5 \pm 2.50	33.1 \pm 2.50	32.9 \pm 2.50	32.3 \pm 2.50
	66.6%	100	67.3%	67.5%	68.1%

Note= Values represents mean \pm standard error of mean of 5 samples in each group (n= 5). Statistical analysis were done by using ANOVA.

Table S16: $clogP$ values for ligands **B8–B14** calculated with ChemDraw 21.0, Molinspiration (www.molinspiration.com) and ALOGPS 2.1.¹

Compound	$clogP$		
	ChemDraw	Molinspiration	ALOGPS 2.1
B8	3.34	3.46	2.67
B9	2.34	2.77	2.63
B10	0.35	1.31	1.06
B11	2.81	2.90	2.38
B12	2.59	2.92	2.10
B13	2.56	2.68	2.55
B14	2.55	2.68	2.53

Table S17. The calculated molecular properties used for the calculation of the quantitative estimate of drug-likeness (QED). MW (molecular weight), $\text{clog}P$ for the compounds **B8–B14** and **Acarbose** using the average $\log P$ of seven different programs via the ALOGPS 2.1 applet at <http://www.vcclab.org>. HBA (hydrogen bond acceptor), HBD (hydrogen bond donor), PSA (polar surface area) calculated via www.molinspiration.com or ChemDraw 21.0 software, ROTB (rotatable bonds), AROM (number of aromatic rings) and Alerts (number of structural alerts). Calculation of the weighted QED for maximum information content (QED_w^{mo}) was carried out according to ref.²

Compounds	MW	ALOGPS	HBA	HBD	PSA	ROTB	AROM	Alerts	Unweighted QED_w^n	Weighted QED_w^{mo}
B8	282.29	2.67	5	0	66.13	3	2	1	0.835	0.810
B9	283.28	2.63	6	1	78.16	4	2	1	0.843	0.869
B10	206.20	1.31	5	0	66.13	2	1	1	0.727	0.682
B11	312.28	2.38	7	0	84.59	3	2	1	0.746	0.804
B12	312.28	2.10	7	1	103.43	4	2	1	0.767	0.862
B13	329.26	2.55	9	1	132.18	4	2	2	0.548	0.663
B14	329.26	2.53	9	1	132.18	4	2	2	0.548	0.663
Acarbose	645.61	-7.11	19	14	321.17	9	0	0	0.064	0.111

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