RESULTS

Biochemical Observations

1. Blood glucose concentration/ 100mL (mg %)

In all groups and subgroups (control and experimental) the blood glucose concentration was measured, tablulated and the results were analysed as follows: -

-Ve control animals (Group IA):

parents (adult animals):-

The results of these animals were collectively presented in Table 1.

In both sexes the blood glucose concentration before mating ranged from 89 to 130 with a mean value of 106.0556 and standard deviation of 12.305.

The blood glucose concentration before they were sacrificed ranged from 95 to 123 with a mean value of 105.111 and standard deviation of 10.459.

GIAa (2 weeks offspring):

The results were present in Table 2

The blood glucose concentration ranged from 80 to 110 with a mean value of 94.15 and standard deviation of 8.712.

GIAb (4weeks offspring):

The results were presented in Table 2.

The blood glucose concentration ranged from 93.5 to 127.5 with a mean value of 110.825 and standard deviation 10.825.

Table (1) Blood glucose levels (mg %) of both parent rats of group I_A before mating and before sacrifice

NO	Before mating	Before Sacrifice
1	94	100
2	88	103
3	96	96
4	108	95
5	112	89
6	107	98
7	99	110
8	98	97
9	100	99
10	103	100
11	95	103
12	90	95
13	120	110
14	125	116
15	119	123
16	115	121
17	110	118
18	130	119
Mean	106.06	105.11
S.D.	12.23	10.46

Table (2) Blood glucose levels (mg %) of group I_A offspring (2 and 4 weeks)

NO	2 weeks	4 weeks
1	85	111
2	84	104
3	80.5	108
4	85	120
5	90	107
6	100	126
7	95	112
8	101	118
9	96	110
10	88	111.5
11	86	106
12	84	123
13	93	94
14	95.5	95
15	83	106
16	103	108
17	110	117
18	108	113
19	96	114
20	101	118
21	104	112
22	92	119
23	90	93.5
24	105	95
25	106	122
26	84	126
27	93	125
28	89.5	127.5
29	86.5	96
30	103	98
31	101.5	127
32	81	125.5
33	109	124
34	82	94.5
35	107	97
36	96.5	98
37	90	100.5
38	88	105
39	94	109
40	100	117
Mean	94.15	110.82
S.D.	8.71	10.82

GIB (+Ve control animals) :

Parents (adult animals) :-

The results of these animals were presented in Table 3.

The blood glucose concentration before mating ranged from 240 to 320 with a mean value of 285.0556 and standard deviation of 27.3978. The blood glucose concentration before they were sacrificed ranged from 290 to 405 with a mean value of 345.333 and standard deviation of 38.6386.

GIB a (2 weeks offspring):

The results of these animals were presented in Table 4.

The blood glucose concentration ranged from 62 to 98 with a mean value of 79 and standard deviation of 11.1497.

GIB b (4 weeks offspring):

The results of this subgroup showed that 4 from 20 offspring were diabetic and represented 20 % so the animals were divided into diabetic (b1) and non diabetic (b2) offspring.

- Diabetic offspring of subgroup B (GIBb1):

The results of these animals were presented in Table 4.

The blood glucose concentration ranged from 205 to 230 with the a mean value of 217.25 and standard deviation of 11.70114.

- Non diabetic offspring of subgroup B (GIB b2):

The results of these animals were presented in Table 4.

The blood glucose concentration ranged from 110 to 161.5 with a mean value of 136.8438 and standard deviation of 13.73647.

Table (3) Blood glucose levels (mg%) of both parent rats of group I_B before mating and before sacrifice

NO	Before mating	Before Sacrifice
1	252	299
2	244	339
3	250	295
4	241	343
5	263	290
6	274	336
7	263	390
8	280	391
9	310	371
10	292	384
11	312	306
12	298	322
13	302	394
14	306	405
15	319	334
16	288	298
17	320	344
18	317	375
Mean	285.06	345.33
S.D.	27.40	38.64

Table (4) Blood glucose levels (mg %) of group I_B offspring (2 and 4 weeks)

NO	2 weeks (Non diabetic)	4 weeks	
		Diabetic	*Non diabetic*
1	74	210	110
2	62	205	151
3	65	224	118.5
4	84	230	129.5
5	70		128
6	83		148
7	72		136.5
8	91		155
9	95		161
10	74		140.5
11	63		132
12	68		120.5
13	94		134.5
14	78		142
15	98		137.5
16	83		145
17	91		
18	77		
19	87		
20	71		
Mean	79	217.25	136.84
S.D.	11.15	11.70	13.74

Experimental groups:-

Group II

Parents (adult animals): -

The results of random blood glucose concentration of parent animals of this group were collectively presented in Table 5

The blood glucose concentration before mating ranged from 343.5 to 415 with a mean value of 383.477 and S.D. of 21.3976.

The blood glucose concentration of animals before sacrifice ranged from 355.5 to 450 with a mean value of 408.0266 and S.D. of 36.7788.

G II a (2 weeks offspring): -

The results of these animals were presented in Table 6.

Blood glucose concentration ranged from 53.5 to 95.5 with a mean value of 76.1944 and standard deviation of 12.130.

G II b (4 weeks offspring):

The results of this experiment showed that 6 from 18 offspring were diabetic and represented 33.3% and so the animals were divided into diabetic (b1) and non-diabetic (b2) rats.

G II b1 (diabetic offspring):

- The results of these animals were presented in Table 6.
- The blood glucose concentration ranged from 250 to 310 with a mean value of 281.333 and standard deviation of 23.4407.

Table (5) Blood glucose levels (mg %) of both parent rats of group II before mating and before sacrifice

NO	Before mating	Before Sacrifice
1	343	355
2	350	380
3	371	441
4	414	450
5	402	398.5
6	399	387
7	405	359
8	387	420
9	409	390
10	370	443.5
11	375	364.5
12	382	419
13	410	449.5
14	352	433
15	377	388.5
16	372	362
17	389	469
18	392	435
Mean	383.28	408.03
S.D.	21.40	36.78

Table (6) Blood glucose levels (mg %) of group II offspring (2 and 4 weeks)

NO	2 weeks (Non diabetic)	4 weeks	
		Diabetic	***Non diabetic***
1	53.5	250	109
2	75	262	122
3	68	310	136.5
4	54	273	122
5	86.5	301	131.5
6	83	292	154
7	95.5		113
8	74		129
9	82		127
10	87		156
11	77		160
12	66		159
13	75		
14	63		
15	90.5		
16	92		
17	73		
18	76.5		
Mean	76.19	281.33	134.92
S.D.	12.13	23.44	18.13

G II b2 (Non-diabetic offspring):

- The results of these animals were presented in Table 6.
- The blood glucose concentration ranged from 109 to 160 with a mean value of 134.9167 and standard deviation of 18.1294.

Group III:

Parents (adult animals):-

- The results of random blood glucose concentration of parent animals of this group were collectively presented in Table 7.
- The blood glucose concentration before mating ranged from 200 to 280 with a mean value of 229.25 and S.D. of 23.5454.
- The blood glucose concentration before sacrifice ranged from 230.5 to 302.5 with a mean value of 266.472 and S.D. of 27.4727.

G III a (2 weeks offspring):

- The results of these animals were presented in Table 8
- The blood glucose concentration ranged from 42.5 to 102 with a mean value of 72.56 and S.D. of 17.5162.

G III b (4 weeks offspring):

- The results of this experiment showed that only 3 from 25 offspring were diabetic and represent 12% and so the animals were divided into diabetic (b1) and non diabetic (b2) rats.

G III b1 (diabetic offspring) :

- The results were presented in Table 8.
- The blood glucose concentration ranged from 210 to 272 with a mean value of 235.333 and S.D. of 32.51666.

Table (7) Blood glucose levels (mg %) of both parent rats of group III before mating and before sacrifice

NO	Before mating	Before Sacrifice
1	200	230
2	209	242
3	222.5	239.5
4	255	235.5
5	280	300
6	262	272
7	274	247
8	210	300.5
9	203.5	293
10	215	288.5
11	224.5	298
12	230	291
13	228	286
14	208	242
15	226	254
16	231	301.5
17	221	240
18	227	236
Mean	229.25	266.47
S.D.	23.5454	27.4727

Table (8) Blood glucose levels (mg %) of group III offspring (2 and 4 weeks)

NO	2 weeks (Non diabetic)	4 weeks	
		Diabetic	*Non diabetic*
1	42.5	210	45
2	45.5	224	58
3	52	272	62
4	64		54
5	100		63
6	92		81
7	74		53
8	88		72
9	80		62
10	65		78
11	84		83
12	53.5		46
13	56		49
14	69		82
15	99.5		90
16	95.5		92.5
17	63.5		85.5
18	68		66
19	73		95
20	77		96
21	87		75
22	81		47
23	93		
24	68		
25	43		
Mean	72.56	235.33	69.77
S.D.	17.52	32.52	16.94

G III b2 (Non diabetic offspring):

- The results of these animals were presented in Table 8.
- The blood glucose concentration ranged from 45 to 96 with a mean value of 69.7727 and S.D. of 16.94018.

Group IV:

Parents (adult animals):-

- The results of random blood glucose concentration of parent animals of this group were collectively presented in Table 9.
- The blood glucose concentration before mating ranged from 245 to 347 with a mean value of 287.889 and S.D. of 32.7398.
- The blood glucose concentration of both sexes before sacrifice ranged from 233.5 to 359 with a mean value of 2.77.361 and S.D. of 44.3136.

G IVa (2 weeks offspring):

- The results of these animals were presented in Table 10.
- Blood glucose concentration ranged from 61 to 100.5 with a mean value of 79.425 and S.D. of 12.32058.

G IV b (4 weeks offspring) :

- The results of these animals showed that 5 from 20 offspring were diabetic and represented 25 % and so the animals were divided into diabetic (b1) and non diabetic (b2) rats.

Table (9) Blood glucose levels (mg %) of both parent rats of group IV before mating and before sacrifice.

NO	Before mating	Before sacrifice
1	245	236
2	256	233.5
3	290	243
4	307.5	260
5	248	245
6	310.5	280
7	252	273
8	246	276.5
9	264.5	305.5
10	309	235
11	301	307.5
12	294.5	359
13	312	313
14	338.5	358
15	347	348
16	323	235
17	272	240
18	265.5	244.5
Mean	287.89	277.36
S.D.	32.74	44.31

Table (10) Blood glucose levels (mg %) of group IV offspring (2 and 4 weeks)

NO	2 weeks (Non diabetic)	4 weeks	
		Diabetic	*Non diabetic*
1	61	230	109
2	69	243	112
3	72	282	108
4	82	250	115
5	83	264	150
6	64		142
7	88		145
8	67		156
9	73		133
10	79		130
11	100		124
12	77		134
13	99		110
14	93		113
15	95		153
16	84		
17	62.5		
18	75.5		
19	94		
20	70.5		
Mean	79.43	253.80	128.93
S.D.	12.32	19.98	17.28

1. GIV b1 (diabetic offspring):

- The blood glucose concentration ranged from 220 to 282 with a mean value of 253.8 and S.D. of 19.9799 (Table 10).

2. G IV b2 (non diabetic offspring):

- The results of these animals were presented in Table 10.
- The blood glucose concentration ranged from 108 to 156 with a mean value of 128.9333 and S.D. of 17.2 8115.
- For comparing the results of the different groups, tables showing the mean and SD for the blood glucose level of adult rats of positive control group and experimental groups (Table 11) as well as those of two weeks offspring (Table 12) and 4 weeks offspring (Table 13) were used in statistical analysis.

Table (11) Showing the mean and standard deviation (SD) for the blood glucose level (mg %) of the adult rats of group I_B(+ve control) as well as all experimental groups.

	Group I_B		Group II		Group III		Group IV	
	Before mating	*Before sacrifice*	*Before mating*	*Before sacrifice*	*Before mating*	*Before sacrifice*	*Before mating*	*Before sacrifice*
Mean	285.055	345.333	383.277	408.027	229.258	266.472	287.888	277.361
SD	27.397	38.638	21.317	36.778	23.545	27.772	32.739	44.313

* Significant at $P< 0.01$
** High significant at $P< 0.005$

Table (12) Showing the mean and standard deviation (SD) for blood glucose level (mg %) of group I_B (+ve control) offspring as well as all experimental groups of 2 weeks age.

	Group I_B	Group II	Group III	Group IV
Mean	79	76.194	72.56	79.425
SD	11.149	12.130	17.516	12.320

* Significant at $P < 0.01$
** High significant at $P < 0.005$

Table (13) Showing the mean and standard deviation (SD) for blood glucose level (mg %) of group I_B (+ve) control) offspring as well as all experimental groups of 4 weeks age.

	Group I_B		Group II		Group III		Group IV	
	Diabetic	*Non-diabetic*	*Diabetic*	*Non-diabetic*	*Diabetic*	*Non-diabetic*	*Diabetic*	*Non-diabetic*
Mean	217.25	136.843	281.333	134.916	235.333	69.772	253.8	128.933
SD	11.701	13.736	23.440**	18.129	32.516	16.940	19.979*	17.281

* Significant at $P< 0.01$

** High significant at $P< 0.005$

Histological Observations

Chromium haemotoxylin and phloxine

The islets of Langerhans appeared at all age groups more or less as pale stained spheriodal masses arranged in the form of irregular anastomosing cords of epithelial cells. Nuclei of some cells were markedly vesicular and their chromatin content was poor. Other nuclei were less vesicular and contained richer amounts of chromatin. No granules could be detected in the cytoplasm of the cells by the routine method. Numerous blood sinusoids were separating the cords of epithelial cells.

-Ve control animals

The islet of -ve control adult rat showed that:

α cells formed a thin and incomplete cortical layer at the peripheral zone. Nuclei of α cells were markedly vesicular with poor chromatin contents. The main mass of the islet appeared to consist of β-cells arranged in the form of interlacing cords penetrated by blood sinusoids. The nuclei of β-cells were less vesicular with good amount of chromatin and large in diameter (Fig. 1)

- In immature control rats (2 weeks) there was an apparent decrease of β-cells in sections (Fig 2).
- Relative increase of β-cell number also at the age of 4 weeks was noticed. Also α-cells tended to group together with eosinophilic cytoplasm (Figs. 3 & 4).

+ ve control animals:

- In adult rat: marked eosinophilia of α cells with relative increase of their number were noticed (Fig. 5).

- Degenerative changes in β-cells started with pyknosis and karyorrhexis in their nuclei (fig. 6) accumulation of watery droplets inside their cytoplasm (hydropic degeneration) and lastly ballooning of B cells with complete loss in severe diabetes leaving multiple cavitations occupying their places (Fig. 7).
- In immature 2 weeks age rats (a): Less degenerative changes in non diabetic hyperglycemic rats (Fig. 8).
- In 4 weeks age rats (b): The degenerative changes in β-cells and the degree of it depended on the level of blood glucose whether diabetic (>200 mg/dl) (Fig. 9) or non diabetic hyperglycemic (>120 mg/dl < 200 mg/dl) (Fig. 10).

Group II: In adult rats severe degeneration of β-cells was observed.

In immature 2 weeks and 4 weeks rats less degenerative change was noticed (Fig. 11).

Group III: The degenerative changes in β-cells are less than that of the above groups (Fig. 12).

Group IV: The degree of β-cell degeneration depended on the age of rats and the level of blood glucose whether diabetic or non diabetic as + ve control group.

Fig (16):A higher magnification of Fig (15) α cells increased relative to β cells in 2 weeks age group.

Modified Aldehyde fuchsin stain, Obj. 100 x, Proj. 10x

Fig. (1) : A photomicrograph of a section in –ve control adult rat islet of Langerhans showing the central localization of β-cells with large less vesicular nuclei and peripheral localization of α-cells. Note the blood sinusoids between cell cords (arrow)

Chromium haematoxylin and phloxine, Obj. 40 x, Proj. 10 x.

Fig (2): A photomicrograph of a section in –ve control islet of rat at the age of 2 weeks with relative low number of β-cells in section. Note the presence of α-cells at the periphery (arrow)

Chromium haematoxylin and phloxine, Obj. 40 x, Proj. 10 x.

Fig (3): A photomicrograph of a section in –ve control islet of rat at the age of 4 weeks with relative increase of β-cells and decrease of α cells. Note the eosinophilia of α cell cytoplasm (arrow).

Chromium haematoxylin and phloxine, Obj. 40 x, Proj. 10 x.

Fig (4): A photomicrograph of a section in – ve control islet of rat at the age of 4 weeks showing that α cells grouped together with eosinophilic cytoplasm (arrow)
Chromium haematoxylin and phloxine, Obj. 100 x, Proj. 10x

Fig (5): A photomicrograph of a section in +ve control adult islet with marked oesinophilia of α-cells and relative increase in their number (arrows)
Chromium haematoxylin and phloxine, Obj. 40 x, Proj. 10 x.

Fig (6): A photomicrograph of a section in +ve control adult islet showing pyknosis and karyorrhexis of β-cell nuclei with hydropic degeneration of the cells.
Chromium haematoxylin and phloxine, Obj. 100 x, proj. 10x

Fig (7): A photomicrograph of a section in the +ve control adult islet with complete loss of β-cells and multiple cavitations occupying their places (arrow)
Chromium haematoxylin and phloxine, Obj. 100 x, Proj. 10x

Fig (8): A photomicrograph of a section in +ve control 2 weeks off-spring islet with less degenerative changes in β-cells (arrow)
Chromium haematoxylin and phloxine,Obj. 40 x, Proj. 10x

Fig (9): A photomicrograph of a section in +ve control 4 weeks diabetic offspring showing more degeneration in β-cells and cavitation (arrow) Chromium haematoxylin and phloxine, Obj. 40 x, Proj. 10x

Fig (10): A photomicrograph of a section in +ve control 4-weeks non diabetic (hyperglycemic) offspring with degenerative changes of β –cells. Chromium haematoxylin and phloxine, Obj. 40 x, Proj. 10x

Fig (11): A photomicrograph of a section in offspring islet of Group II showing less degeneration of β-cells (arrow)
Chromium haematoxylin and phloxine, Obj. 40 x, Proj. 10x

Fig (12): A photomicrograph of a section in Group III offspring islet of rat at the age of 4 weeks simulating the picture of –ve control with minor degenerative changes
Chromium haematoxylin and phloxine, Obj 100x, Proj. 10x

Modified Aldehyde fuchsin stain:

- **-ve control animals:-**

Different types of cells could be identified:

A-cells:- mainly peripheral in position and with yellow cytoplasmic granules. Nucleus appeared rounded or elliptical and usually eccentric in position with marked vesicular pattern and poor chromatin contents distributed into few small spherical masses.

B-cells:- The most of cells located centrally with violet cytoplasmic granules. Nucleus appeared rounded and centrally placed inside the cells. Nucleus was less vesicular than A cells and contained rich amount of chromatin seen as fine strands forming a network. (Figs. 13 & 14).

In immature (2 weeks) offspring there was decrease in amount of β-cells in section (Figs. 15 & 16).

In 4 weeks offspring there was relative increase in amount of β-cells in section in relation to 2 weeks age offspring. (Fig. 17).

- **+ ve control animals:**

Degenerative changes in β-cells were seen as those observed by Chromium haematoxylin and phloxine stain (Figs. 18 &19).

In 2 weeks age offspring:- less degeneration in non diabetic offspring (Fig. 20).

In 4 weeks offspring: in diabetic ones the degenerative changes in β-cells were more than those in non diabetic hyperglycemic (Figs 21 & 22).

- **Group II and group IV :** The results were analogous to those described with Chromium haematoxylin and phloxine stain
- **Group III:** Less degeneration in β-cells in adult and 4 weeks offspring than other groups. The picture was nearly as –ve control results

Fig (13): A photomicrograph of a section in adult –ve control rat showing the peripheral location of α-cells with yellow cytoplasmic granules and β-cells are located centrally with purple cytoplasmic granules
Modified Aldehyde fuchsin stain, Obj. 40 x, Proj. 10x

Fig (14): A higher magnification of Fig (13) showing the peripheral localization of α-cells with yellow cytoplasm (arrow)

Modified Aldehyde fuchsin stain, Obj. 100 x, Proj. 10x

Fig (15): A photomicrograph of a section in -ve control 2 weeks age, α-cells increased relative to β-cells (arrows indicate α -cells) .
Modified Aldehyde fuchsin stain, Obj. 40 x, Proj. 10x

Fig (16):A higher magnification of Fig (15) α cells increased relative to β cells in 2 weeks age group.

Modified Aldehyde fuchsin stain, Obj. 100 x, Proj. 10x

Fig (17): A photomicrograph of a section in 4 weeks offspring of – ve control rat showing relative increase in β-cells in comparison to 2 weeks age group. Modified Aldehyde fuchsin stain, Obj. 40 x, Proj. 10x

Fig (18): A photomicrograph of a section in adult +ve control group showing that degenerative changes in β cells in the form of pyknosis, karyorrhexis and cavitations in the place of lost β-cells

Modified Aldehyde fuchsin stain, Obj. 40 x, Proj. 10x

Fig (19): A higher magnification of Fig (18) showing degeneration of β-cells, with cavitation of its sites (arrow indicte degenerated β-cells)

Modified Aldehyde fuchsin stain, Obj. 100 x, Proj. 10x

Fig (20): A photomicrograph of a section in 2 weeks offspring with less degeneration of β-cells.

Modified Aldehyde fuchsin stain, Obj. 40 x, Proj. 10x

Fig (21): A photomicrograph of a section in 4 weeks age diabetic offspring of +ve control showing destruction of β-cells with cavitation, pyknosis and karyorrhexis of β-cell Nuclei

Modified Aldehyde fuchsin stain, Obj. 100 x, Proj. 10x

Fig (22): A photomicrograph of a section in the islet of non diabetic 4 weeks offspring showing less degenerative changes.

Modified Aldehyde fuchsin stain, Obj. 100 x, Proj. 10x

Quantitation Study:

Determination of β-cell percentage:

Control group

GIA (-ve control):

The results of animals of this group and their offspring were collectively presented in Table 14.

Parents: (Adult animals):

The β-cell percentage ranged from 68.5% to 82.4% with a mean value of 62.222 and SD of 4.613.

G IA a (2 weeks):

The β cell percentage ranged from 51.6% to 79.2% with a mean value of 65.812 and S.D of 8.925.

G1 Ab (4 weeks):

The β-cell percentage ranged from 65.5% to 80.8% with a mean value of 74.165 and SD. Of 4.749.

GIB (+ ve control):

The results of this group were collectively presented in Table 15.

parents (adult animals).

The percentage of β-cells ranged from 40.1% to 49.2% with a mean value of 44.905 and S.D. of 3. 127

G1B a (2 weeks) :

The percentage of β-cells ranged from 64.8% to 86.5% with a mean vale of 75.3 and S.D. of 7.160.

Table (14) % of pancreatic β-cells in group I_A.

NO	Adults	2 weeks	4 weeks
1	73.6	70.2	79.6
2	68.5	61.4	76.2
3	72.4	60.5	73.6
4	70.7	77	75.4
5	69.1	78	80.8
6	71.3	63.4	74.3
7	80.4	62.6	80.2
8	81.2	51.6	79.4
9	75.3	54.3	74.3
10	77.5	55.7	69.8
11	77	56.8	75
12	78.6	69.7	77.2
13	82.4	70	67.5
14	79.5	71.1	65.5
15	76.1	65.2	66.2
16	81.6	66.3	79.6
17	82.7	63.7	78.8
18	74.1	60.4	79
19		53.6	72.7
20		66.5	73
21		72.4	78.5
22		79.2	76.1
23		78	77.3
24		76	68.7
25		45.7	66.4
26		62.8	74
27		71.6	73.8
28		64.3	75.2
29		57	70.2
30		58.1	80.6
31		69.2	80
32		68.2	71.6
33		78.4	69
34		79.1	69.3
35		77.8	68.2
36		59.9	67.1
37		56	77
38		54.7	68
39		67.1	79.5
40		79	78
Mean	62.22	65.81	74.17
S.D	4.61	8.93	4.75

Table (15) % of pancreatic β-cells in group I_B.

NO	Adults	2 weeks	4 weeks	
			Diabetic	*Non-diabetic*
1	41.1	66.5	45.1	78.1
2	42	77.1	44.2	63.2
3	40.1	86.4	44.4	70
4	43.2	84.2	47.1	54.1
5	46	75.1		60.2
6	47.6	73.2		76.5
7	47.8	70		78.7
8	49.2	64.8		76.9
9	48.2	69.1		64.1
10	48.7	72.6		63
11	40.6	65		66
12	42.8	67		65.1
13	45.7	73		62.3
14	43.6	74.8		72.2
15	45	80.7		74.4
16	41.4	85.6		75.1
17	46.2	83.2		
18	49.1	72.3		
19		84.4		
20		81		
Mean	44.91	75.30	45.20	74.07
S.D	3.12	7.16	1.32	7.13

G1Bb1 (4 weeks diabetic):

The percentage of β-cells ranged from 44.4% to 47.1 with a mean value of 45.2 and S.D. of 1.324.

G1Bb2 (4 weeks non diabetic):

The percentage of β-cells ranged from 54.1% to 78.1% with a mean value of 74.068 and S.D. of 7.132.

Group II

The results of this group were collectively presented in Table (16)

Parents (adult animals):-

The percentage of β-cells ranged from 45-3% to 57.3% with a mean value of 50.927 and S.D. of 4.239 .

GII a (2 weeks):

The percentage of β-cells ranged from 70.5% to 86.1% with a mean value of 78.555 and S.D. of 5.751.

G II b1 (4 weeks Diabetic):

The percentage of β-cells ranged from 43.8% to 56-2% with a mean value of 50.8 and S.D. of 5.002 1

G II b2 (4 weeks non diabetic)

The percentage of β-cells ranged from 54.5% to 80.2% with a mean value of 67.636 and S.D. of 10. 1641.

Table (16) % of pancreatic β-cells in group II.

NO	Adults	2 weeks	4 weeks	
			Diabetic	*Non-diabetic*
1	50.1	80.5	56.2	69.5
2	51.4	82.6	53.4	78.6
3	45.5	86.1	50.9	63.5
4	46	72.2	43.8	57.4
5	48.2	73.5	54.7	55.2
6	45.3	75.6	45.8	61.5
7	47.3	70.5		66.1
8	52.5	81.7		78.3
9	54.6	85.3		79.5
10	53	72.4		80.2
11	55.6	73.6		54.2
12	56.2	71.3		72.5
13	56.7	74.4		
14	54	83.1		
15	47.1	86		
16	57.3	85.2		
17	45.4	75.9		
18	50.5	84.1		
Mean	50.93	78.56	50.80	67.64
S.D	4.24	5.75	5.00	10.16

Group III

The results of this group were collectively presented in Table (17)

Parents (adult animals):

The percentage of β-cells ranged from 59.3% to 78.5% with mean value of 60.15 and S.D. of 4.427.

GIII a (2 weeks):-

The β-cell percentage ranged from 55% to 77.2 % with a mean value of 64.876 and S.D. of 6.409.

G III b1 (4 weeks Diabetic):

The β-cell percentage ranged from 53% to 61.7 % with a mean value of 64.876 and S.D. of 6.409.

G III b2 (4 weeks non diabetic):

The β-cell percentage ranged from 63.2% to 79.1% with a mean value of 70.809 and S.D. of 5.359.

Group IV

The results of this group were collectively presented in Table (18).

Parents (adult animals):

The percentage of β-cell ranged from 42.2% to 54.5% with a mean value of 48.711 and S.D. of 3.866.

G IV a (2weeks):

The percentage of β-cell ranged from 69.2% to 88.7 % with a mean value of 78.67 and S.D. of 6.820.

Table (17) % of pancreatic β-cells in group III.

NO	Adults	2 weeks	4 weeks	
			Diabetic	*Non-diabetic*
1	55.4	56.5	60.9	64.5
2	56.3	55.1	53	63
3	60.2	60.2	61.7	63.2
4	61.1	57.6		70.1
5	63.4	63.2		72.4
6	53.1	64.3		69.5
7	56	58.5		71.8
8	65.5	59.4		65.7
9	57.4	61.2		68.8
10	66.2	65.3		73.2
11	58.5	66.7		75.1
12	57.1	70.1		79.1
13	66.5	73.4		68
14	54	72.1		63.5
15	62.3	65.2		70
16	64.6	64.3		74.6
17	65.6	74.5		76.9
18	59.5	62.8		77.1
19		63.7		68.2
20		55		79
21		65.3		78.6
22		66		65.5
23		77.2		
24		67.3		
25		77		
Mean	60.15	64.88	64.88	70.81
S.D	4.43	6.41	6.41	5.36

Table (18) % of pancreatic β-cells in group IV.

NO	Adults	2 weeks	4 weeks	
			Diabetic	*Non-diabetic*
1	43.2	80.1	43.5	54.1
2	53.1	82.4	54.6	55.3
3	50.2	79.3	40.7	52.2
4	49.6	87.6	49.8	71.5
5	44.3	69.2	54.5	72.7
6	46.4	88.7		63.4
7	48.6	81.2		75.8
8	42.9	75.5		70.6
9	51.1	66.5		64.9
10	50.3	65.5		61.2
11	52.8	71.4		79.7
12	43.1	74.3		65.4
13	45	86.6		60.6
14	54.5	80.7		50.3
15	53.9	83.2		53.5
16	47.6	84		
17	48.2	79.1		
18	52	78.9		
19		73.7		
20		85.5		
Mean	48.71	78.67	48.62	63.41
S.D	3.87	6.82	6.34	9.22

G IV b1 (4 weeks diabetic):

The percentage of β-cell ranged from 40.7 % to 54.5% with a mean value of 48.62 and S.D. of 6.337.

G IV b2 (4 weeks non diabetic)

The percentage of β-cell ranged from 50.3 % to 79.7% with a mean value of 63.413 and S.D. of 9.217.

For comparing the results of the different groups, tables showing the mean and SD for β-cell percentage in adult rats of positive control groups and experimental groups (Table 19) as well as those of 2 weeks offspring (Table 20) and 4 weeks offspring (Table 21) were used in statistical analysis.

Table (19) Showing the mean and standard deviation (SD) for the % of pancreatic β-cells of group I_B (+ve control) adults as well as all adult experimental groups

	Group I_B	Group II	Group III	Group IV
Mean	44.905	50.927	60.15	48.711
SD	3.127	4.239	40427	3.866**

* Significant at P< 0.01
** High significant at P< 0.005

Table (21) Showing the mean and standard deviation (SD) for the % of pancreatic β-cells of group I_B (+ve control) offspring as well as all experimental groups of 4 weeks age.

	Group I_B		Group II		Group III		Group IV	
	Diabetic	*Non-diabetic*	*Diabetic*	*Non-diabetic*	*Diabetic*	*Non-diabetic*	*Diabetic*	*Non-diabetic*
Mean	45.2	74.069	50.8	67.636	58.533	70.809	48.62	63.413
SD	1.324	7.132	5.002	10.146	4.808**	5.359	6.337	9.217**

* Significant at P< 0.01
** High significant at P< 0.005

Table (20) Showing the mean and standard deviation (SD) for the % of pancreaticβ-cells of group I_B (+ve control) offspring as well as all experimental groups of 2 weeks age.

	Group I_B	Group II	Group III	Group IV
Mean	75.3	78.556	64.876	78.67
SD	7.160	5.751	6.409	6.820

* Significant at $P< 0.01$
** High significant at $P< 0.005$

Bone marrow observations

Chromosomal study:-

Metaphase studies of albino rat chromosomes revealed that the number of chromosomes was 42 in the form of 40 autosomes and 2 sex chromosomes.

The sex chromosomes in female rat were similar and were of xx cell lines (Fig. 23).

The sex chromosomes in male rat were in the form of an x chromosome and a Y chromosome. (Fig 24). In the present study the main chromosomal abnormalities encountered were gaps. (Fig 25), breaks (Fig. 26), ring chromosomes (Fig. 27), deletion (Fig. 28), chromatid separation (Fig. 29), polyploidy (Fig. 30), hypodiploid (Fig 31) and hyperdipliod complements (Fig. 32). In all groups and subgroups (control and experimental) the different chromosomal abnormalities (numerical and structural) were scored, tabulated and the results were analyzed as follows:-

Fig (23):- Photomicrograph of a normal metaphase chromosomal spread (42 chromosomes) of a female rat (arrows indicate the x chromosemes) .
Giemsa stain, Obj. 100x, Proj. 10x.

Fig (24): Photomicrograph of normal metaphase chromosome spread prepared from a bone marrow of a normal male albino rat (arrows show the x and y chromosomes) .

Giemsa stain, Obj. 100x, Proj. 10x.

Fig (25): Photomicrograph of a metaphase chromosomal spread with chromatid gap (arrow).

Giemsa stain, Obj. 100x, Proj. 10x.

Fig (26): Photomicrograph of a metaphase chromosomal spread with chromatid break (arrow)

Giemsa stain, Obj. 100x, Proj. 10x.

Fig (27): Photomicrograph of a metaphase chromosomal spread with ring chromosome (arrow).
Giemsa stain, Obj. 100x, Proj. 10x.

Fig (28): Photomicrograph of a metaphase chromosomal spread with chromatid deletion (arrow)

Giemsa stain, Obj. 100x, Proj. 10x.

Fig (29): Photomicrograph of a metaphase chromosomal spread with chromatid separation (arrow)

Giemsa stain, Obj. 100x, Proj. 10x.

Fig (30): Photomicrograph of a metaphase chromosomal spread with polyploidy (84 chromosomes)
Giemsa stain, Obj. 100x, Proj. 10x.

Fig (31): Photomicrograph of a metaphase chromosomal spread with hypoploidy (41 chromosome)
Giemsa stain, Obj. 100x, Proj. 10x.

Fig (32): Photomicrograph of a metaphase chromosomal spread with hyperploidy (43 chromosomes)
Giemsa stain, Obj. 100x, Proj. 10x.

G IA (-ve control animals)

Parent animals

The results were collectively presented and tabulated in Table (22) and the percentage of chromosomal aberrations were calculated as follows:-

Total structural abnormalities (2.46 %)

Total aneuploidy (0.88%)

Total polyploidy (0.33%)

G1Aa (2 weeks)

The results were collectively presented in Table (23) and the percentage of chromosomal aberrations were calculated as follows:

- Total structural abnormalities (2.06%)
- Total aneuploidy (0.58%)
- Total polyploidy (0.40%)

G1Ab (4 weeks):

The results were collectively presented in Table (24) and the percentage of chromosomal aberrations were calculated as follows:

- total structural abnormalities (1.57%)
- Total aneuploidy (0.45 %)
- Total polyploidy (0.25%)

GIB (+ ve control animals)

- ***Parent animals:-***

The results were collectively presented in Table (25) and the percentage of chromosomal aberrations were calculated as follows

- Total structural abnormalities (2.55%)
- Total aneuploidy (0.77%)
- Total polyploidy (0.44%)

Table (22) Chromosomal anomalies encountered in 50 examined metaphases/ rat in adults of group I_A.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	1	1	0	0	2	0	1	0	1
2	0	0	0	0	0	0	0	0	1	1
3	0	1	0	0	0	1	0	1	0	1
4	0	0	0	0	0	0	1	0	0	1
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	1	1	0	0	0	0
7	0	1	0	0	0	1	1	0	0	1
8	0	1	0	1	1	3	0	0	0	0
9	1	1	1	1	0	4	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	1	0	0	0	1	1	2
12	0	0	1	0	1	2	1	0	0	1
13	0	0	0	1	0	1	0	0	0	0
14	1	0	0	0	0	1	0	0	1	1
15	0	0	0	1	1	2	0	0	0	0
16	0	0	1	0	0	1	0	1	1	2
17	0	1	0	1	0	2	0	0	0	0
18	1	0	0	0	1	2	0	0	0	0
Sum	3	6	4	6	5	24	3	4	4	11
%	0.33	0.66	0.44	0.66	0.55	2.64	0.33	0.44	0.44	1.21

Table (23) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 2 weeks offspring of group I_A.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	1	0	0	0	1	0	0	0	0
2	0	0	0	0	1	1	1	0	0	1
3	0	0	1	1	1	3	0	0	0	0
4	1	0	1	0	0	2	0	0	0	0
5	0	1	0	0	0	1	0	1	0	1
6	0	0	0	0	0	0	1	0	1	2
7	1	0	1	0	1	3	0	0	0	0
8	1	1	0	0	0	2	0	0	0	0
9	0	0	0	1	0	1	0	0	0	0
10	1	0	0	0	1	2	0	0	0	0
11	0	0	1	0	0	1	1	1	0	2
12	0	0	0	0	1	1	0	0	1	1
13	0	0	0	0	0	0	0	0	0	0
14	1	1	0	0	0	2	1	0	0	1
15	0	0	1	0	0	1	0	0	1	1
16	1	0	0	0	0	1	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	1	0	0	0	0	1	0	0	1	1
20	0	0	1	0	1	2	1	1	0	2
21	0	0	0	0	0	0	0	0	0	0
22	1	1	0	1	0	3	0	0	0	0
23	1	0	1	0	0	2	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0
25	1	0	0	0	0	1	0	1	0	1
26	0	0	0	0	0	0	0	0	0	0
27	0	1	0	0	0	1	1	0	0	1
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	1	0	1	0	0	1	1
30	0	0	1	0	0	1	0	0	0	0
31	0	0	1	0	1	2	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
33	1	0	0	0	0	1	1	0	0	1
34	0	0	0	0	0	0	0	1	0	1
35	0	1	0	0	0	1	0	0	0	0
36	1	0	0	1	0	2	0	0	0	0
37	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	1	0	0	1
39	0	0	0	1	0	1	0	0	0	0
40	0	0	0	0	0	0	0	0	1	1
Sum	12	7	9	6	6	40	8	5	6	19
%	0.60	0.35	0.45	0.33	0.33	2.06	0.40	0.25	0.33	0.98

Table (24) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 4 weeks offspring of group I_A.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	1	0	1	0	0	2	0	1	0	1
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	1	0	0	1	0	0	0	0
5	1	1	0	0	0	2	1	0	0	1
6	0	0	0	0	1	1	0	0	0	0
7	0	0	0	1	0	1	0	0	1	1
8	0	0	0	0	0	0	0	0	0	0
9	0	0	1	0	0	1	1	0	0	1
10	1	1	0	0	0	2	0	1	0	1
11	0	0	0	0	0	0	0	0	0	0
12	0	1	0	0	0	1	0	0	1	1
13	0	0	0	0	1	1	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	1	0	1	0	0	0	0
16	0	0	0	0	0	0	1	0	0	1
17	1	0	1	0	0	1	0	0	0	0
18	0	0	0	0	1	2	0	1	0	1
19	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	1	1
22	0	1	0	1	1	3	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0
24	1	0	1	0	0	2	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0
26	0	0	1	0	1	2	1	0	0	1
27	0	1	0	0	0	1	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	1	1	2
31	0	0	0	1	0	1	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	1	1	1	0	0	1
37	1	0	0	1	0	2	0	0	0	0
38	0	1	0	0	0	1	0	0	1	1
39	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0
Sum	6	6	6	5	6	29	5	4	5	14
%	0.33	0.33	0.33	0.25	0.33	1.57	0.25	0.2	0.25	0.70

Table (25) Chromosomal anomalies encountered in 50 examined metaphases/ rat in adults of group I_B.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	0	0	1	0	1	0	1	0	1
2	0	1	0	0	0	1	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	1	0	1	1	3	0	0	0	0
5	1	0	0	0	0	1	0	1	1	2
6	0	1	1	0	0	2	0	0	0	0
7	0	0	0	0	1	1	0	0	0	0
8	0	0	0	1	0	1	1	0	0	1
9	1	0	1	0	0	2	0	1	0	1
10	0	0	0	0	1	1	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	1	0	0	0	0	1	1	0	1	2
13	0	1	1	1	0	3	1	0	0	1
14	0	1	0	0	1	2	0	1	0	1
15	1	0	0	0	0	1	0	0	0	0
16	0	0	1	0	0	1	0	0	0	0
17	0	0	0	0	0	0	1	0	0	1
18	1	1	0	0	0	2	0	0	1	1
Sum	5	6	4	4	4	23	4	4	3	11
%	0.55	0.67	0.44	0.44	0.44	2.55	0.44	0.44	0.33	1.22

G1Ba (2 weeks):

The results were collectively presented in Table (26) and the percentage of chromosomal aberrations were calculated as follows:-

Total structural abnormalities	(2.46%)
Total aneuploidy	(0.90%)
Total polyploidy	(0.33%)

GIB b1 (4 weeks diabetic)

The results were collectively presented in Table (27) and the percentage of chromosomal aberrations were calculated as follows:-

Total structural abnormalities	(3%)
Total aneuploidy	(0.5%)
Total polyploidy	(0.5%)

G1B b2 (4 weeks non diabetic)

The results were collectively presented in Table (28) and the percentage of chromosomal aberrations were calculated as follows

Total structural abnormalities	(2.65 %)
Total aneuploidy	(0.87%)
Total polyploidy	(0.50%)

Group II

Parent animals:

The results were collectively presented in Table (29) and the percentage of chromosomal aberrations were calculated as follows:-

Total structural abnormalities	(2.31%)
Total aneuploidy	(0.66%)
Total polyploidy	(0.33%)

'able (26) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 2 weeks offspring of group I_B.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	1	0	0	0	1	0	0	1	1
2	1	1	0	0	0	2	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	1	1	0	2	0	0	0	0
5	1	0	0	0	1	2	0	1	1	2
6	0	1	0	0	1	2	0	0	0	0
7	0	1	1	0	0	2	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	1	0	1	1	0	3	0	0	0	0
10	0	1	0	0	0	1	0	1	0	1
11	0	0	0	0	1	1	0	0	1	1
12	0	0	0	0	0	0	1	1	0	2
13	0	0	1	1	0	2	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	1	0	0	0	1	2	0	0	0	0
16	0	0	0	0	0	0	1	1	0	2
17	0	1	0	0	0	1	0	0	1	1
18	0	0	1	0	0	1	0	0	0	0
19	0	0	0	0	0	0	1	1	0	2
20	1	0	0	1	0	2	0	0	0	0
Sum	5	6	5	4	4	24	3	5	4	12
%	0.50	0.66	0.50	0.40	0.40	2.46	0.33	0.50	0.40	1.23

Table (27) Chromosomal anomalies encountered in 50 examined metaphases/ rat In 4 weeks diabetic offspring in group I_B.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	1	0	0	0	0	1	1	0	0	1
2	0	1	0	0	0	1	0	0	0	0
3	0	0	0	1	1	2	0	0	0	0
4	1	1	0	0	0	2	0	1	0	1
Sum	2	2	0	1	1	6	1	1	0	2
%	1	1	0	0.5	0.5	3	0.5	0.5	0	1

Table (28) Chromosomal anomalies encountered in 50 examined metaphases/ rat In 4 weeks non-diabetic offspring in group I_B.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	1	1	1	0	0	3	1	0	1	2
2	0	0	1	0	1	2	0	0	0	0
3	1	0	0	0	0	1	0	0	0	0
4	0	1	0	1	1	3	0	0	0	0
5	0	0	0	0	0	0	0	0	1	1
6	1	0	0	0	0	1	1	1	0	2
7	0	0	0	0	0	0	1	0	0	1
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	1	1	0	0	0	0
10	1	1	1	1	0	4	0	1	0	1
11	0	0	0	0	0	0	0	0	1	1
12	0	0	0	0	1	1	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0
14	0	0	1	0	0	1	1	1	0	2
15	0	0	0	1	0	1	0	0	1	1
16	0	1	1	0	1	3	0	0	0	0
Sum	4	4	5	3	5	21	4	3	4	11
%	0.50	0.50	0.65	0.37	0.65	2.65	0.50	0.37	0.50	1.37

Table (29) Chromosomal anomalies encountered in 50 examined metaphases/ rat in adults of group II.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	0	0	0	0	0	0	0	0	0
2	0	0	1	1	1	3	0	0	0	0
3	0	0	0	0	0	0	0	0	1	1
4	0	0	1	0	0	1	0	0	0	0
5	1	0	0	1	0	2	0	1	0	1
6	1	1	0	0	2	4	0	0	0	0
7	0	0	0	0	0	0	1	0	1	2
8	1	1	0	0	0	2	0	1	0	1
9	0	0	0	0	0	1	0	0	0	0
10	0	0	0	1	1	1	0	0	1	1
11	0	0	0	0	0	0	0	0	0	0
12	1	1	0	0	0	2	0	0	0	0
13	0	0	0	1	1	2	0	0	1	1
14	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	1	0	0	1
16	1	0	1	0	1	3	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	1	0	0	1
Sum	5	3	3	4	6	21	3	2	4	9
%	0.55	0.33	0.33	0.44	0.66	2.31	0.33	0.22	0.44	0.99

G II a (2 weeks):-

The results were collectively presented in Table (30) and the percentage of chromosomal aberrations were calculated as follows

- Total structural abnormalities (2.42%)
- Total aneuploidy (0.99%)
- Total polyploidy (0.44%)

G II b1 (4 weeks diabetic):

The results were collectively presented in Table (31) and the percentage of chromosomal aberrations were calculated as follows

- Total structural abnormalities (2.98 %)
- Total aneuploidy (0.33%)
- Total polyploidy (0.66 %)

G II b2 (4 weeks non diabetic)

The results were collectively presented in Table (32) and the percentage of chromosomal aberrations were calculated on follows:-

- Total structural abnormalities (2.65%)
- Total aneuploidy (0.66 %)
- Total polyploidy (0.50%)

Group III:

Parent animals:

The results were collectively presented in Table (33) and the percentage of chromosomal aberrations were calculated as follows:

- Total structural abnormalities (2.31%)
- Total aneuploidy (0.88 %)
- Total polyploidy (0.44%)

G III a (2 weeks):

Table (30) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 2 weeks offspring in group II.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	0	0	0	1	1	0	0	1	1
2	0	0	0	0	0	0	0	0	0	0
3	1	1	0	0	0	2	0	0	0	0
4	0	0	1	1	0	2	0	0	1	1
5	0	0	1	0	1	2	1	1	1	3
6	1	0	0	0	0	1	0	0	0	0
7	1	0	0	0	0	1	0	1	0	1
8	0	1	0	1	0	2	1	0	0	1
9	0	0	0	0	1	1	0	0	0	0
10	0	0	0	0	0	0	0	0	1	1
11	1	0	0	0	1	2	0	1	0	1
12	0	1	1	0	0	2	0	0	0	0
13	0	0	0	1	0	1	0	0	1	1
14	0	0	0	0	0	0	0	0	0	0
15	1	0	0	0	1	2	1	0	0	1
16	0	0	0	0	0	0	0	1	0	1
17	0	1	0	0	0	1	0	0	0	0
18	0	0	0	1	1	2	1	0	0	1
Sum	5	4	3	4	6	22	4	4	5	13
%	0.55	0.44	0.33	0.44	0.66	2.42	0.44	0.44	0.55	1.43

Table (31) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 4weeks diabetic offspring in group II.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	1	0	0	0	1	2	0	0	0	0
2	1	1	0	0	0	2	0	0	0	0
3	0	0	0	0	1	1	0	0	1	1
4	0	1	0	1	1	3	1	0	0	1
5	0	0	0	0	0	0	0	0	0	0
6	0	0	1	0	0	1	1	0	0	1
Sum	2	2	1	1	3	9	2	0	1	3
%	0.66	0.66	0.33	0.33	1	2.98	0.66	0	0.33	0.99

Table (32) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 4 weeks non-diabetic offspring in group II.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	1	0	0	1	2	0	0	1	1
2	0	0	0	1	0	1	0	0	0	0
3	1	0	0	0	0	1	0	1	0	1
4	0	1	0	1	1	3	0	0	0	0
5	0	0	1	0	0	1	0	0	1	1
6	0	0	0	0	1	1	0	0	0	0
7	1	1	0	1	0	3	1	0	0	1
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	1	1	0	0	1	1
10	1	0	0	0	0	1	1	0	0	1
11	0	1	1	0	0	2	0	0	0	0
12	0	0	0	0	0	0	1	0	0	1
Sum	3	4	2	3	4	16	3	1	3	7
%	0.50	0.66	0.33	0.50	0.66	2.65	0.50	0.16	0.50	1.16

Table (33) Chromosomal anomalies encountered in 50 examined metaphases/ rat in adults of group III.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	1	0	1	0	2	0	0	1	1
2	0	0	1	0	1	2	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	1	0	0	1	0	2	0	0	1	1
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	1	0	0	1	2	0	0	0	0
8	1	0	0	1	0	2	1	0	1	2
9	0	1	0	0	0	1	0	1	0	1
10	0	0	1	0	1	2	0	0	0	0
11	0	0	0	0	0	0	1	0	0	1
12	1	0	0	0	0	1	1	0	0	1
13	0	0	0	1	0	1	0	0	1	1
14	1	0	0	0	1	2	1	1	0	2
15	0	0	1	0	0	1	0	0	0	0
16	0	1	0	0	0	1	0	0	0	0
17	1	0	0	0	1	2	0	0	1	1
18	0	0	0	0	0	0	0	1	0	1
Sum	5	4	3	4	5	21	4	0.3	5	12
%	0.55	0.44	0.33	0.44	0.55	2.31	0.44	33	0.55	1.32

The results were collectively presented in Table (34) and the percentage of chromosomal aberrations were calculated as follows:-

- Total structural abnormalities (2.16%)
- Total aneuploidy (0.80%)
- Total polyploidy (0.40%)

G III b1 (4 weeks diabetic) :

The results were presented in Table (35) and the percentage were calculated as follows:

- Total structural abnormalities (2.65%)
- Total aneuploidy (0.66%)
- Total polyploidy (0.66%)

G III b2 (4 weeks non diabetic)

The results were collectively presented in Table (36) and the percentage of chromosomal aberrations were calculated as follows:-

- Total structural abnormalities (2.25%)
- Total aneuploidy (0.81%)
- Total polyploidy (0.36%)

Group IV:

Parent animals

The results were collectively presented in Table (37) and the percentage of chromosomal aberrations were calculated as follows:-

- Total structural abnormalities (2.86 %)
- **Total aneuploidy (0.55 %)**
- Total polyploidy (0.33 %)

Table (34) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 2 weeks offspring in group III.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	0	0	0	1	1	0	0	0	0
2	0	0	0	0	0	0	0	1	0	1
3	1	1	0	0	0	2	0	0	1	1
4	0	0	1	1	0	2	1	0	0	1
5	0	1	0	0	0	1	0	0	0	0
6	0	1	1	0	0	2	0	1	0	1
7	1	0	0	1	1	3	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	1	0	1
10	0	1	0	1	0	2	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	1	0	1
13	0	1	0	1	0	2	0	0	1	1
14	1	0	0	0	1	2	0	1	0	1
15	0	0	1	0	0	1	1	0	0	1
16	0	0	0	0	0	0	0	0	0	0
17	0	1	0	0	1	2	0	0	1	1
18	0	0	0	0	0	0	1	0	0	1
19	0	0	0	0	1	1	0	0	0	0
20	1	0	0	0	0	1	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0
22	0	0	0	1	1	2	0	1	0	1
23	0	0	0	0	0	0	1	0	0	1
24	1	0	1	0	0	2	0	0	1	1
25	0	0	0	0	1	1	1	0	0	1
Sum	5	6	4	5	7	27	5	6	4	15
%	0.40	0.48	0.32	0.40	0.56	2.16	0.40	0.48	0.32	1.20

Table (35) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 4 weeks diabetic offspring in group III .

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	1	0	1	1	3	0	0	1	1
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	1	0	1	1	0	0	1
Sum	0	1	0	2	1	4	1	0	1	2
%	0	0.66	0	1.33	0.66	2.65	0.66	0	0.66	1.32

Table (37) Chromosomal anomalies encountered in 50 examined metaphases/ rat in adults of group IV.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	1	1	0	1	3	0	0	1	1
2	0	0	0	0	0	0	0	0	0	0
3	1	1	0	0	0	2	0	0	0	0
4	0	0	0	1	1	2	0	1	0	1
5	0	0	0	1	0	1	0	0	0	0
6	1	0	1	0	1	3	0	0	0	0
7	0	1	0	0	0	1	1	0	0	1
8	0	0	0	0	0	0	0	0	0	0
9	1	0	0	1	0	2	0	1	1	2
10	0	0	0	0	0	0	0	0	0	0
11	0	0	1	1	1	3	1	0	0	1
12	0	0	0	0	0	0	0	0	0	0
13	1	0	0	0	0	1	0	0	0	0
14	0	1	1	1	0	3	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0
16	1	0	0	0	1	2	1	0	0	1
17	0	1	0	1	0	2	0	0	0	0
18	0	1	0	0	0	1	0	1	0	1
Sum	5	6	4	6	5	26	3	3	2	8
%	0.55	0.66	0.44	0.66	0.55	2.86	0.33	0.33	0.22	0.88

G IV a (2 weeks):-

The results were collectively presented in Table (38) and the percentage of chromosomal aberrations were calculated as follows:-

- Total structural abnormalities (2.6%)
- Total aneuploidy (0.50%)
- Total polyploidy (0.40%)

G IV b1 (4 weeks diabetic)

The results were collectively presented in Table (39) and the percentage of chromosomal aberrations were calculated as follows: d

- Total structural abnormalities (2%)
- Total aneuploidy (0.80%)
- Total polyploidy (0.40%)

G IV b2 (4 weeks non diabetic)

The results were collectively presented in Table (40) and the percentage of chromosomal aberrations were calculated as follows

- Total structural abnormalities (1.67%)
- Total aneuploidy (0.53%)
- Total polyploidy (0.40%)

Table (38) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 2 weeks offspring in group IV.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	1	0	0	1	2	0	0	0	0
2	0	1	0	0	0	1	0	0	0	0
3	1	0	1	0	0	2	0	0	0	0
4	0	0	0	1	1	2	0	1	1	2
5	0	0	0	0	0	0	0	0	0	0
6	1	0	1	0	0	2	1	0	0	1
7	0	1	0	0	0	1	0	0	0	0
8	0	0	0	0	1	1	1	0	0	1
9	0	1	1	1	0	3	0	1	0	1
10	1	0	0	0	0	1	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	1	1	1	0	0	1
13	0	0	1	1	0	2	0	1	0	1
14	1	1	0	0	0	2	0	0	1	1
15	0	0	0	0	0	0	0	0	0	0
16	0	1	1	0	1	3	1	0	0	1
17	1	0	0	0	0	1	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0
20	0	0	1	0	1	2	0	0	0	0
Sum	5	6	6	3	6	26	4	3	2	9
%	0.5	0.6	0.6	0.3	0.6	2.6	0.4	0.3	0.2	0.9

Table (39) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 4 weeks diabetic offspring in group IV.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	0	0	0	1	1	0	1	0	1
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	1	0	1	0	0	0	0
4	0	0	0	0	1	1	1	1	0	2
5	0	1	0	0	1	2	0	0	0	0
Sum	0	1	0	1	3	5	1	2	0	3
%	0	0.4	0	0.4	1.2	2	0.4	0.8	0	1.2

Table (40) Chromosomal anomalies encountered in 50 examined metaphases/ rat in 4 weeks non-diabetic offspring in group IV.

NO	Structural Aberrations						Numerical aberration			
	Gap	Break	Ring	Deletion	Ch. Separation	Total	Poly	Hypo	Hyper	Total
1	0	0	0	1	0	1	0	0	0	0
2	0	1	0	0	0	1	1	0	1	2
3	0	0	0	0	0	0	0	1	0	1
4	0	1	0	0	0	1	0	0	0	0
5	0	0	0	0	1	1	0	0	0	0
6	0	0	0	1	0	1	0	0	0	0
7	0	0	0	0	0	0	0	1	0	1
8	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	1	0	1
10	1	0	1	0	0	2	0	0	0	0
11	0	0	0	0	1	1	0	0	0	0
12	0	0	0	0	0	0	1	0	0	1
13	1	0	0	0	1	2	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	1	0	0	0	1	1	0	0	1
Sum	2	3	1	2	3	11	3	3	1	7
%	0.27	0.40	0.13	0.27	0.40	1.67	0.40	0.40	0.13	0.93