RESULTS AND DISCUSSION

4. Results and Discussion

4.1. Effect of carbaryl on clinical signs:

Rats treated with 1/10 LD_{50} of carbaryl insecticide developed clinical symptoms which were progressing by time. Marked distention of the abdomen was the only clinical symptoms observed in rats alter the first two weeks of treatment. In the third week, rats lost their vitality and showed ruffled coat and depression. Some rats developed nervous manifestations and moved in circles.

During the remaining weeks of the experiments, general weakness and cachexia were observed. animals were reluctant to move and showed nervous manifestations and hurried respiration. The symptoms of toxicity of carbaryl in rats \\ ere similar to that reported by *Smalley (1970).* The previous author attributed these symptoms to the intense parasympathetic stimulation of carbaryl. The same symptoms of toxicity were recorded in rats intoxicated with carbaryl *(Yakut., 1967; Mount et* itt, *1981)* and in mice *(Ahtlaya et. al., 1976);* and in Guinea pigs (*Grammer, 1986).*

4.2. Effect of carbaryl on Body weight and organ weights:

The effects of carbaryl on body weight are recorded ill table (2), since it was observed a significant decreases in body weight of rats. The loss of the body weight was directly proportional to the increase of the $I.D_{5}o$. hf recovery the decrease in body weight was smaller than the treated group,. but the body weight did not reach to the level of the control group.

These results are in agreement with the results of *Hamada (1987)* who reported that in one year study with dogs, carbaryl in the diet at 1250 ppm reduced body weight, increased liver weight. Also, *Carpenter et. al., (1961)* reported that carbaryl in diet of rats for 2 years at 400 ppm (20 mg/kg/day)

Table (2) Effect of carbaryl admInIslratIon on body weight and some organs weight of rats In grams

Weight in grains		Control	Wt in treated rats 1/30	1/20	1/10	Recovery
Body weight loss	Mean,	247	217.7 -	198.3	183.5	209.6
	SD	11.81	3.12	2.67	5.02	6.04
Liver weight	Mean	9.9	10.47	10.58	11.13 *	10.13
	so	0.48	0.52	0.58	0.63	0.39
Kidney weight	Mean	2.96	3.16	3.24	2.77	2.88
	so	0.169	0.16	0 1 I	0.06	0.12
Testis weight	Mean	2.68	2.208	2.117	1.683	1.9
	so	0.025	0.08	0.09	0.5	0.085

* P - 0 05
** = 0 01
*** P 0 001

depressed the body and organs weight.

4.3. Effect of carbaryl on serum biochemical components:

Estimation of results of some blood biochemical parameters in serum of the rats treated with carbaryl for 12 weeks and in recovery for another 12 weeks without treatment are shown in tables (3-5).

4.3.1 Serum liver enzymes:

Plasma transaminases activities of AST, ALT and alkaline phosphatascs were determined as indicators of liver functions, since the increase in these activities means that the liver become abnormal case.

The mean values of plasma transaminases activities of alanine transferasc(ALT) aspartate transfer:Ise (AST) and alkaline phosphatase (ALP) were presented in table (3) since it was showed a significant elevation starting from the first two weeks of the experiment onwards to the end of the experiment when compared with the control group. Regarding to plasma AST activity, significant increases were noticed in cal baryl treated rats after 2,6,9, and 12 weeks as compared to control group . The values of the enzyme activities in the recovery group decreased but did not reach to the levels of the normal level, table (3).

Plasma ALT activity was significantly increased in carbaryl treated rats after 2,6,9, and 12 weeks as compared to control group, while decrease in the recovery group but did not reach to the level of the control group, tablc(3).

Plasma alkaline phosphatase activity, was significantly increased in carbaryl treated rats after 2,6,9, and 12 weeks as compared to control group, while decrease in the recovery group but did not reach to the level of control group table (3).

I he esenl study could be supported by the histopalhological observalion of lesions in Ills liver. The itsidls resembles to the resell of *Carpenter el. at, (1961)* who reported Thal plasma AST, Al /f and alkaline phosphatase activities were incensed in cm Innyl and Hint incense may be due to sensitive biochemical marker of in vivo toxicity

Rat' and l'odder (1983) and Hasson (1971) reported that oral administration of eatbaryi to rats at dosage ranging from 50-5(10 mg/kg kiwi gave incense in activation or scrum enzymes. The clevnlion of transaminase activities in plasma may be due to the tissue &image pallicularly in liver, kidney and heel. *Paraffita and Otero (1984).* Also it was observed as incense in pcmeability of the cell membrane and incense or decrease for catabolism of hansaminase *etat, 1980).* he lqeasc of specilic fissile enzyme into the blood slreanr is dependant on both the degree and hype of damage ()veiled by calbaryl adminislralion *et. al., (1981).* 'I hese results were coincidence with the results of the present study.

4.3.2. Serum

13ilinibin is formed when hemoglobin is metabolized by the reticllo--indothelial system. Bilitubi» is protein bound in the plasma and conjugated in the liver. Plasma bilirubin levels have been used as au indicator of liver function *(Burtis, and Ashwood, 1994).*

Scrum ()MIAMI level in control and treated rats are suvnnarired in (able (3). Carbaryl heated rats showed a significant increase in serum bilirubin levels in comparison to control group within 12 weeks.

These results are in accordance with those of *Carpenter ant, (1961).* *'Flie* increase in plasma bilirubin levels may be due to some causes of overproduction of bilinthm such as intravascular hemolysis.

		control	2 weeks	4 weeks		9 weeks		
				11/30 1/20 1'10				
Sample/? Mak		r• 3^	1 4S 0.82 0.63	0.53 0.79 C 90'	0.69 0.8 1 .03	0.89, 1.05 1.1	1.09 1.45	10.75
		|		015 0.2 C.02	0.05 0.1 0 06	0.09' 0.1 0.]9	0.16 0.1 0.06	0.]
ALT 1_1	Mean		3'2 6 366.5 336 3:	421 7 4504:;5.5	ES0.3 317.5 328.3	317 4 371.0403.8	46; S 503 1539?'	I 315.6 I
	SD		7 3 66.5-98 4	78 886.786	526 59.6 78.65	486 65 8 43.6	82 6 • 55.6 1 44.5 1	73.5 I
AST L>l.	Mean I :14		12: :.3 250.0 253.21	232 4 276 2 3:3	292.5 _.1 339.6	[illegible]	315.5 333.5 1 455.3'	265.6
	SD	1 65.5	-, 1 56 3 45.31	35 9 35.6 ; 65.7	45.9 633 5S.6	48 6' 35 6 66 31	53 3 586 1 90.3	56.3
					109.5' 83.5 84.5	76 6 98 5 i116.5	88.6 106 136	83.6
			S6 6.8 7 9		9.8 S.6 11.3	105 - 8.6 ! 7 66	9 .6 7.6 [illegible]	9.3

* P = 0.05
** P = 0.01
*** P = 0.001

FT

4.33. Effect on kidney function tests:

Serum urea and creatinine were determined as indicators of kidney functions, since the increase in these components means that the kidney are less active or abnormal case.

Mean values of serum urea and creatinine were elevated throughout the experiment. The significant uremia was noticed during the 9th week of treatment. In recovery the levels of urea and mainline started to decrease in their levels but did not reach to the normal level of control group, table (4).

The elevation of blood urea and creatinine in treated rats may be attributed to the toxic effect of carbaryl which led to disorders of the kidney which reduced the glomerular filtration rate and consequently retention of urea in the blood *(Sonnenwirth and Jaren, 1980).*

The results were closely resembling to those obtained by *lialuny (1994* who revealed increase in blood urea in rats after sublethal dosing of thiocarb for 4 weeks. *Abdel Satan? eta/ (1982) and Sand (1992)* reported that the observation of kidney lesions would indicate involvement of the kidney in the excretion of the insecticide. It is suggested that uremia was clue to increase of body protein catabolism, decrease of renal blood flow as a result of the general circulatory distress or renal damage from the insecticide. The present finding also are in agreement with those of *Sabbhy (1987).*

4.3.4. Serum uric acid:

The results in table (4) showed that the values of serum uric acid in nits treated with 1 /I 0 51) of carbaryl insecticide increased from the first two weeks of treatment. Results proved to be highly significant increase starting from the 6th week to the end of the experiment. In the recovery the level of the serum uric acid decreased but still more increase than the normal level. The results of the present study are in agreement with the results of *Carpenter (1961);and Mount et.a1, (1981).*

4.3.5. Serum electrolytes:

Results of serum electrolytes showed significant decrease after oral administration of carharyl to rats. Sodium tended to decrease during the 4 th week of treatment and this decrease was extended to the end of expel ˙meat (12 weeks). Potassium decreased from the 6th week of the experiment. The levels were return to nearly high normal in the recovery table (4).

The tendency of the measured electrolytes to decrease may be interpreted by the likelihood impairment of intestinal absorption by the orally received insecticide. Also, decrease of the potassium can occur in association with hyperglycemia and acute pancreatilis, respectively(Co/es, *1986).*

The results of the present study are in agreement with the results of Rahmy, (1994) ‘vho reported that oral administration of thiocarb 1hr 4 weeks decreased the scrum levels of sodium and potassium.

4.3.6. Total lipids and cholesterol:

Values of total lipids showed significant increase throughout the experiment. Significant hypercholesterolemia was noticed, however, from the beginning to the end of the experiment since a sharp increase I4 as observed during the 6th and 9th weeks of treatment. In the recovery the levels decreased to the normal levels. table (5).

The results of the present study are in agreement with the results of *Sobbhy (1987), and Rahntr (1994),* who suggested that hyperlipidemia and hypercholesterolemia is expected to occur in some diseases of the liver,

			2 weeks			4 weeks	6 weeks		9 weeks	12 weeks			
		E o	0C/I	will		1/30i 1/20 1/101	oin		01/1 ' OZ/1 10f/1	1111	j OZ/1	01/1	
Urea mg/d!	Mean	1 91:	LWEE	9SE	LL_F_	9C 91S : c 9t	SZ 6 S0	t 8S	53.6; 57 3 6: 51	f: CS	60S	8<9	8t
	as	91	9S	CZ	[km	CT : IT: 19	c9	pr:	91: t E 1 E	01	6E	CZ	
ti'-'	tiVahl	6'0	90		60	Z I 1IH. ()	CHI	St I	5 1 171	1			it
	as	TO	0		60	ZI 0190 0 10	6000 CI 0	5E7	t 0 , 900 t	x800	500	900	to
1	Weals	sE	017	01:	en	8 E ZT	t 8E	t	S I Et O't	n	c't		
	as		810	El '0	c0	_90 9 0 S0	OI71		El II		;II	Z 0	60
utnpog U63 m	IIValk	ZE 6tI	ZI:Lt1	WI7I71	5 6E11	I ZEL6 8:1 Z tCII	EZ11: 9:1	9 6H	6901,E	I'M	,ZI 7.01 ,EZI COI		C1-7-1
	as		89 1]	I9 EEC		a/C.EL 8 L	L S		Z7. 9 ET 9 IIII C	LC	tt9	9	1ST
Potassium neEq/1	Wcals	—	Z77	i S17		ZIT of 611	O1 E1 1 1		1 61	,67	ST	)07	61
	aS	211		171.1		CIO 911	1 11`o		Jct () CO	14 1	fro	51/	911

***P = 0.001

nephritic syndrome, diabetes mellitus and acute pancreatitis. It is suggested that impairment of liver, kidneys and pancreas by the insecticide had resulted in the observed changes in the serum lipid profile. While *Redo and teileszky (1980) Hann& eta! (1989)* reported that in the histopathological examination revealed vactiolation of the hepatoextes which could be accumulation of lipids due to failure of their phosphorylation of lipids by the liver.

4.3.7. Serum glucose:

The results in table (5) showed that the values of serum glucose in rats treated with $I/10_{50}$ of carbaryl insecticide increased from the first two weeks of treatment. Results proved to be highly significant starting from the 6 th week to the end of the experiment for all treatments. In the recovery the level of the serum glucose deocased but still more increase than the normal level (control).

The results of the present study are in agreement with the results of *Ray and Fodder (1984); and Szeepaniak et. al., (1980) who* reported that administration of carbaryl to the rats led to 11)1)eiglycemia.

Weiss et aL, (1964,1963) and Wakakura et al., (1978), suggested that hyperglycemic in exposure of the rabbits and dogs to carbaryl may be due to increase of sympathoadrenergic activity and led to liberation of caticholamines from the adrenal medulla as a result of accumulation of acetylcholine by the insecticide which affect the hepatic glycogen metabolism. While *Gupta et al (1981)* suggested that hyperglycemia may be attributed to the inhibition of glucose metabolism through pancreatitis and decrease of insulin activity.

			2 weeks I			4weeks		6 weeks	9 weeks		12 weeks			atON3J
			ut	0	O	I01/11	OW OZ/1	1/0£'1/Z0 IOM	01/1 0Z/1		01/1	IOZ/1		
ladypita 101211	unah	I 9 t59	19 8E5.	9E 5Z5	689	15 E59	5 69L19 £ZL	700 3 812.3 838.5'	Z08 .5 Z16	,5 9L6	Z.'598	E 596	1093.5	E ZIL
	aS	995	E St	9 EZ	161	Z95.	£'95 S98	E Z1 5 EZ E ZI	l'SL 91'5		£98	ccb		9 5t
Cholesterol mg/dl	many	SEt	c tt1	9 591		E 591	9'Z1Z 5 col	189.3.200.3.253.5	9 ZIE E69Z1	.9 5CZ	6'ESZ	F5 68Z		9 lalaZ
	as	cm:	zsE	9 Z1		E.9E	9 Et 11 57,	901 EH 951	9 9£ . 9 St	TE 57	5 9E	TZ,	9 EZ	
Glucose mg/t11	Mean	En	11:11	6E1		c 'sL	„5 8LZ9 0tZ	8 ZI E. c'ZZ.Z	1.5Z 9:55Z	c..5EZ	5682	Z 00E	995£	5 081
	us	L	Z 91	9'9	c	c	1'£	Z'9 5 CZ 6	S'6 Z El	Z 8	757		Z9	9'51

4.3.8 Serum cholinesterase activity:

Serum cholinesterase (CUE) activity is composed of two distinct cholinesterases (Acetyleholinestrase and holyrylcholinesterase). Acetylcholinestrase is the true cholinesterase while the butyrylcholinesterase is pseudocholinesterase and present in the plasma. Both acetylcholinestrase and butyrvlcholinesterase have similar inhibitors and activators. Therefore, inhibition butyrylcholinesterase reflects inhibition of acetylcholinestrase. major substrate is acetylcholine, the neurotransmitter found at the myoneural junction. *(Whittaker, 1983).*

Data presented in table(6) indicated that carbaryl administrated caused a high significant decrease in this enzyme activity (readies in some time to more than 50".i, inhibition of the enzyme activity) in comparison to control. On stoppage of treatment in the recovery group, treated animal showed hyper activity of serum cholinesterase activity in comparison to the control group.

This findings arc in agreement with the results of *)'skint* (1967); *Mama dal., (1981); Kossahowshi and lysek,(1982), who* reported that oral, dermal, and inhalation exposure of rats and rabbits to carbaryl resulted in transient acetylcholinestrase inhibition.

4.3.9. Serum protein and albumin:

The results in table (6) showed that the values of serum protein and serum albumin in rats treated with 1/10 $_{50}$ of carbaryl insecticide decreased from the first two weeks of treatment. Results proved to be significant decrease starting from the 6th week to the end of the experiment for all

			2 weeks						6 weeks			9 weeks			12 wed		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	96.3	[illegible]	[illegible]	[illegible]

* $P = 0.05$
** $P = 0.01$
** $P = 0.001$

Acetyl cholinesterase

treatments hnlhc recovery, the level of the small protein and albumin decreased when compared with the normal level (control).

The results of the present study were in agreement with the results of *Ray and Podder, (1984); and Szezepaniak et. al. , (1980),* who reported that administration of carbaryl to the rats led to hypoproteinemia.

4.4. Hematological changes:

Data presented in table (7) indicated that prolonged administration of carbaryl in doses of 1/30,1/20 and 1/10 for 2 weeks, 4 weeks, 6 weeks, 9 weeks, and 12 weeks caused a significant decrease in leticocytic count, erythrocytic count, hemoglobin concentration hetnatocrite value and blood indices in treated rats. The platelet count showed highly significant decrease in treated rats in comparison to the control group. The values of hematological parameters Mier stoppage of treatment for 90 days in the recovery group increased but not reached to the values of control group.

While the results of the present study me in agreement with *Paget (1970, who* reported that, the red cells were low in hemoglobin concentration and stained poorly, i.e. hypochromic, in cases of long term poisoning with hepatotoxic agents. Also *Lox, (1984), Krug and Berndt (1985),* reported that, carbaryl reduced the platelets count.

4.5 Male fertility and reproductive system parameter changes:

Carbaryl was studied from the reproductive toxicity aspect or view as male fertility effects. Albino rats were selected for application of this investigation as ideal models For male fertility studies *(Rareellona et at, 1977).*

			2 weeks			6 weeks		9 weeks			12 weeks		recovery
						[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	
[illegible]	Mean	[illegible]	[illegible]	[illegible]	1.8z	10.07"10.74	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	gift
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]	Mean	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	GS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			27.35 22.3*	[illegible]
	GS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]
	[illegible]		[illegible]					1 983 96 3					

4.5.1 Testicular eight:

Mean value of testis weight and spermatozoid examination including concentration of sperm cells, motility, and live and dead sperms of carbaryl treated rats are recorded in tables(8).

The testis weight showed significant decrease at the end of 12"i week in comparison to that of control group. While in recovery group after stoppage of treatment for another 12 weeks caused insignificant increase in the testicular weight.

4.5.2Concentration of sperm cells

Data presented in table (8) indicated that the concentration of sperm cells in carbaryl treated rats at closes of 1/30 and 1/201.Dm i showed significant decrease at 12'[th] week of the experiment, followed by highly significant decrease at dose of I/10 LD;,), in comparison to the control group. In the recovery group the concentration of sperm insignificantly changed.

4.5.3 Percentage of live sperms:

Data presented in table(8), indicated that the percentage of live sperms in carbaryl treated groups recording significant decrease at the 1/30 and 1/20 LDS) followed by highly significant decrease at I/10 ID;,, in comparison to control group. Data also recorded significant increase of the percent of live sperms after stoppage of carbaryl administration but not reached to the percentage of that of the control group.

4.5.4 Percentage of active motile sperms:

Data presented in Table (8), indicated that the percentage of actively motile sperms in carbaryl treated groups recording significant decrease at the 1/30 and 1/20 1..D5, followed by highly significant decrease at IRO 1_,D_{50} in comparison to control group. Data also recorded significant increase of the percentage of actively motile alter stoppage of carbaryl administration but did not reach to the percent of that of the control pout).

4.5.5. Percentage of abnormal form of sperms:

Data presented in table (8), indicated that the percentage of head abnormal form of sperms in carbaryl treated groups recording significant increase at the 1/30 and 1120 LD50 followed by significant increase of total and tail abnormal form of sperms at 1/10 1D50 in comparison to control group

From the obtained results it can be concluded that the effect of carbaryl on testis weight and spermatozoal examination was significantly affected by the carbaryl insecticide administration especially at 1/10 LD30, while in recovery the recurrence to the normal state has not completely occurred. In summary regarding to male fertility, the present study showed that oral administration of carbaryl at a dose of (1/10 ID50) for 60 successive days to male rats showed significant decrease in the weights of testes, but at doses (1/20 LD50), (1/30 LD50) showed insignificant change in the weights of testes. Oral administration of carbaryl for 12 weeks to male rats showed significant decrease in concentration of sperm cells, live sperm and motility, but significant increase in the percentage of abnormalities of sperms were observed. The obtained results were confirmed by the histopathological examination which revealed that carbaryl inhibited spermatogenesis and testicular function due to degeneration, and desquamation of germinal layers of seminiferous tubules especially with the higher doses. Detached necrotic germinal cells and multinucleated spermatidc were found in the Lumina of the degenerated tubules table (8) and fig.(3 a-e).

Table (8) Effect of carbaryl administration on reproductive parameters of rats.

		Control	Treated rats 1/30	1/20	1/10	Recovery
•ett IR f Venn in ‹X ir pe,,,,it idid mi.0	Mean	62	34.83	31 **	29.17	39.5
	SD	3.4	4.09	3.37	2.56	2.656
cone. (Opens! motility in %	Mean	62	34.17	27.17'	16.5	50.67
	SD	7.9	2.74	2.42	2.5	5.94
conc. M r fire sperm in %	Mean	86.33	59.83	52.33	39.83	63.33
	SD	3.81	3.93	2.25	4.19	10.95
conc. of sperm abnormality in %	Mean	12.3	15.3	16.9	20.3	16.5
	SD	1.2	1.6	1.5	1.1	2.1

* P = 0.05
** P = 0.01
***I* = 0001

The present study are in agreement with the results of *(Collins et al 1971),* who reported that carbaryl at 1000 ppm impaired fertility, while *Sobbhy (1987); and Makhlouf (1993)* found that the methomyl caused decrease the weight of testes as well as sperm count. The percentage of living and reserve sperms of testicles and epididymis were decreased.

4.6. 1.1)5,,

Regarding to the estimation of oral LD_{50} carbaryl it was found to be 74.4 mg/kg B wt. From the present study, carbaryl is considered moderately toxic substance at different doses according to *(Boyd and Boulanger 1968)).* The difference in the results may be attributed to the variation in the carbaryl used, dosage, route of administration and duration of experiment besides the species of the laboratory animals as differences between species are in part due to differences in the metabolism and pharmacokinetics of drugs *(Nenbert etal 1977).*

4.7. Postmortem changes:

These results were in agreement with the results of *Hamada (1987)* who reported that in one year study with dogs, carbaryl in the diet at 1250 ppm reduced organs weight, increased liver weight. Also *Carpenter et at, (1961)* reported that carbaryl in diet of rats for 2 years at 400 ppm (20 ing/kg/day) depressed the organs weight.

Congestion of different body organs with the presence of petechial hemorrhages and splenomegaly were the most prominent findings observed in rats administrated carbaryl. The severity of lesions was correlated with frequency of carbaryl exposure.

4.8. Ilistopathological findings:

4.8.1. Liver:

Control group

The normal structure of hepatic lobules and hepatocytes, hepatocytes form columns of cells adherent to each other by one or more surfaces. Bile canaculi were present in between two columns of hepatocytes. At least, one surface of any hepalocyle was on contact with liver sinusoids. The cytoplasm often appeared coarsely granular with empty vacuolated areas where lipid droplets have been dissolved during preparation of the section. The nuclei were spherical, centrally located and variable in size and with one nucleolus. Ilepatocytes may be binucleated. The sinusoids were variable in diameter and lined by discontinuous sheet of endothelial cells with flat nuclei, Kupfler's cells also located in the sinusoidal walls fig.(1 a).

First group:

The hepatocytes showed cytomegalic changes in size and the cytoplasm was granular and vacuolar fig.(1 b). Hepatic cell nuclei appeared fragmented chromatin. "Iliere was severing activation and proliferation of the KupfTer's cells, along the hepatic sinusoids. Most of the hepatic blood vessels were dilated.

Second group:

The sinusoidal dilation increased. Most of the hepatic cells were enlarged and the cytoplasm was granular and vacuolar. The hepatic cell nuclei appear fragmented. Fig.(I c).

Third group:

There were loss of cell architecture and increased degeneration of hepatic cells. Most of hepatic cells were necrotic (has no nuclei) fig.(d).

Recovery group:

Sonic of cells returned to normal cell architecture and most of cells didn't return to (heir normal architecture lig.(I e).

These results are in agreement with the results of *Boman etat,(1991)* who reported that, after 4 weeks of administration of carbaryl on hepatic cells were vacuolated and their nuclei were pyknotic and degenerated. Mier 5 weeks the degeneration was more pronounced by vacuolated hepatic cells were pyknotic and degenerated nuclei and limitation of spaces in between the hepatic cords.

etal., (1992) added that effect of carbaryl on liver of fish were vactiolation and cellular degeneration. The effect might be due to inhibition of intracellular activity by carbaryl or might be due to depletion of glycogen and protein inside liver cells.

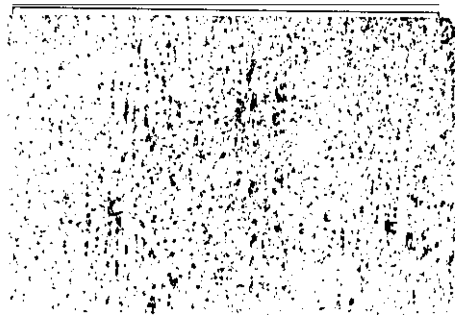
4.82 Kidney:

Control group:

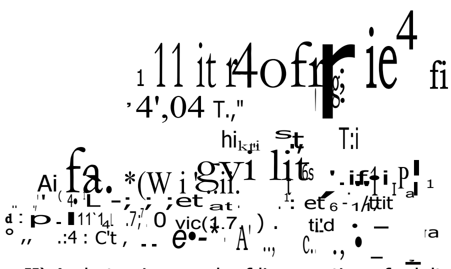
The histological structure of the renal cortex of the control group showed the normal structure of both renal corpuscles and tubules. The renal corpuscles appeared as dense rounded structures known as glomendi which were surrounded by narrow spaces called Bowman spaces fig. (2 a).

The Bowman's capsule consisted of an inner or visceral layer covering the glomerulus and an outer layer or partial layer and the Bowman's space in between.

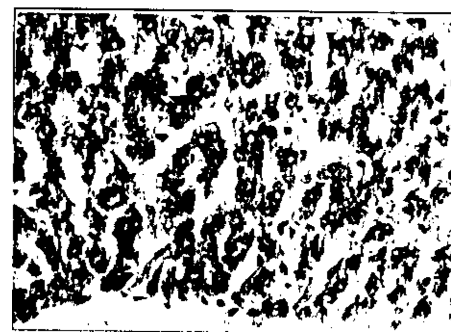
The visceral layer consisted of branching epithelial cells called the podocytes. These cells were relatively large and their nuclei bulge in the capsular space. At the urinary pole, the partial layer become continuous with the wall of the proximal convoluted tubule, while the Bowman's space become continuous with lumen of the proximal convoluted tubule.



(a) A photomicrograph of nonnal liver section of adult albino rat of the control group showing: Central vein (C), hepatic cord (11), radiating from central vein. *(/4".mntavy/in & Eosin X* 150).

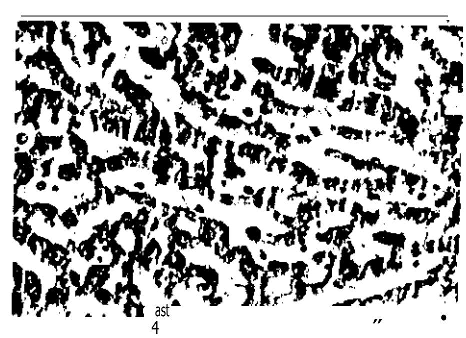


(II) A photomicrograph of liver section of adult albino nit of the first group showing:
a) Intracytoplasmle vacuolation of different sizes.
b) Widening blood sinusoids denoting degenerating hepatic cells. *Ofnentatory/in* & */ min X 4001*



(c) A photomicrograph of liver section of adult albino rat of the second group showing: Most of hepatic cells were enlarged *and* the cytoplasm was granular and vacuolar. Ilepatic cell nuclei appeared fragmented chromatin.). Hepatic blood sinusoids were dilated. *Ilaeintrunylin & Eosin X 400)*

(d) A photomicrograph or liver section of adult albino *rat* of the third group showing: Loss of cell architecture. Increased degeneration of hepatic cells. Some of cells has no nuclei (Necrotic cells). Some of hepatic nuclei has fragmented chromatin and widening of blood sinusoids. *(Mentromylin & Eosin ,Y 1000)*



(4) A photomicrograph olliver section of adult albino rat of the recovery group showing: Some of cells realm to normal cell structure (regenerating cell . The hepatocytes were enlarged and showed granular cytoplasm and other areas showed irregular cell arrangement.(/fnemmtery7in & *Eosin X 1000)*

Figure (I) Photomicrographs showing histopathological effects of carbaryl on the liver of rats

The wall of the parietal layer was composed of simple squamous epithelium resting on a thin basal lamina. The tubules which comprised the major portion of the renal corpuscle differed from one another as regards (heir diameter, staining of cytoplasm and nuclei.

The tubules which were seen in the section consisted mainly of proximal convoluted tubules and some distal convoluted tubules and scattered sections of other tubules. Small blood vessels were also seen between the lobules. The proximal convoluted tubules were lined by a single layer of low columnar or pyramidal cells with rounded nuclei and granular cytoplasm which stained deeply with eosin.

First group:

The capillary tuft appeared smaller in size with partial endothelial vacuolation. The 13ownian's space was increased. 'Hie convoluted tubules were widely separated, some of them showed foci of necrosis while others appeared normal fig.(2 b).

Second group:

The glomenili capillary appear small in size with partial endothelial vactiolation. There were also cloudy swelling and degenerative narrow or obliterated Bowman's spaces fig. (2 c). The proximal, distal and collecting tubules were dilated.

Third group:

The changes in renal corpuscles increased with marked distortion. The intedubular spaces w ere marked increased. There were increased in cloudy swellings and degenerations fig.(2 d).

Recover)' group:

The most of cortical areas regenerated the normal architecture of &mead' and tubules. Some of cells were still degenerated fig.(2

These results were in agreement with the results of *Carpenter et. al,(1961)* who reported that toxic effect of carbaryl on the kidney tissue was cloudy swelling of the epithelial cells of the proximal convoluted tubules of the kidneys of rats and dogs fed 400 ppm of carbaryl for several months.

Gill et.al (1988) reported that exposure of fish to low dose of carbaryl for 30 days caused hypertrophy, vacuolation, nuclear pyknosis in the absorptive surface of the tubular epithelium. These effects may be attributed to be (Inc damage of cell permeability barrier resulting in leakage of metabolites together with vital enzyme. These results were in agreement with the present study.

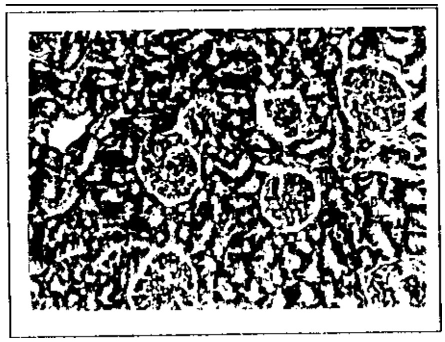
These result were in agreement with the result of *Baronia et.* At *(1991) who* found that, afler 5 weeks of carbaryl administration, collecting, proximal, distal tubules showed dilatation and rupture of the glomeruli.

Also the obtained results were in agreement with *Dhanpakian and Joliet (1994)* and *Stvilunt (1996 a)* who reported that, exposure of fish to carbaryl for 15 day's caused hypertrophy of renal cells, vacuolation and necrosis of renal components.

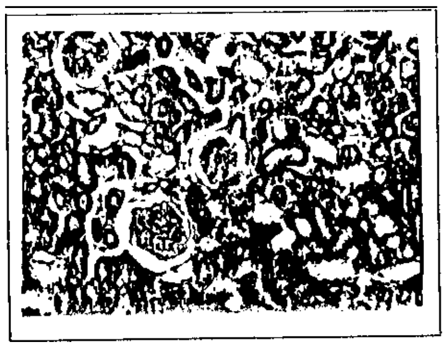
4.8.3. Testis:

Control group:

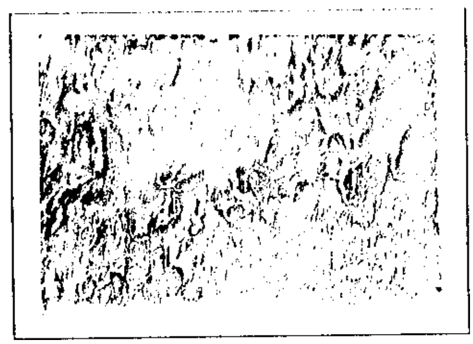
The testes of the control rats showed normal histological pattern which is build up of seminiferous tubules and the interstitial cells were found in between the tubules. These tubules were rounded or oval in cross sections and contained different stages of spennatogenic cycle. The Lumina of seminiferous tubules were filled with spermatozoa. The interstitial cells were 'regular polyhedral cells with large spherical nuclei figL3 a).



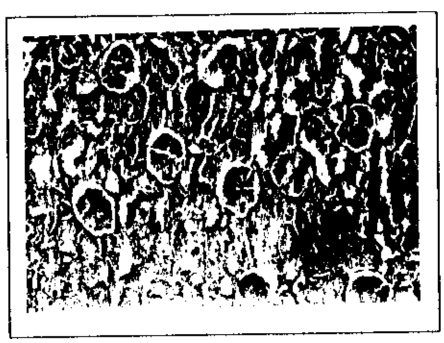
(a) A photomicrograph o1 normal kidney section amid(albino rat of the c mtrol group showing: Renal capsule (It). Proximal con :Mined tubules (I') and distal convoluted tubules(0). *(hwinalorylin rB Eosin X 600)*



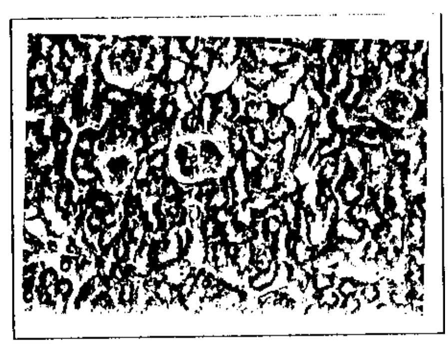
(b) A photomicrograph of kidney section of adult albino rat of the first group showing: Glomerular capillaries (G), appear small in size with partial endothelial vacuolation (').Convoluted tubules were widely separated and show foci *nectosisf Ilaernenorylin R Eosin X 600).*



(c) A photomicrograph of kidney section of adult albino rat of the second group showing: the tubules show cloudy swelling and degeneration of separated spar 's. The proximal, distal, collecting lobules are dilated. *(Thwmatavylin & Eosin X 600).*



(d) A photomicrograph of kidney section of adult albino rat of the third group showing: Increase in cloudy swelling and degeneration of tubular cells. Distortion of glomeruli with widely separated *spaces.(11aermiarylin &Eosin X1000).*



(e) A photomicrograph of kidney section of adult al hi rat of the recovery group showing: The tubules show nonnal epithelial lining and normal lumen. Complete recovery of some glonicruli.(Thiemaroxylint *Eosin X600)*

Figure (2) Photomicrographs showing histopathological effects of carbaryl on the kidney of rats

First group:

Mild to moderate degree of degenerative changes in germinal layers of seminiferous tubules in the limn of appearance of vacuolation. There are also irregular arrangement in the germinal layers fig.(3 b).

Second group:

The testis showed moderate degree of degenerative changes of different series of spermatogenic with beginning of appearance of large number of spermatid giant cell inside seminiferous tubules lig.(3 c).

Third group:

Severe degree of degenerative changes in germinal layers of seminiferous tubules with engorgement of blood vessels. Increased number of spermatid giant cell inside seminiferous tubules fig.(3 d).

Recorecr group:

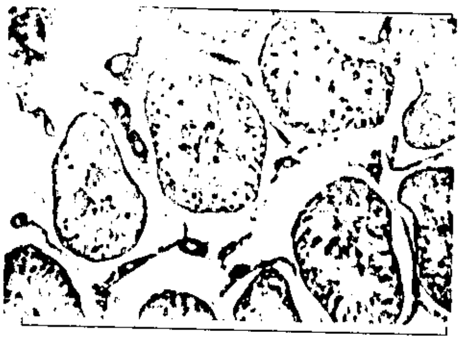
There were some of regenerating cells with presence of huge number of immature sperms. The interstitial cells appear normal fig.(3 e).

These results are in agreement with the results of *Sktenberg and Rybakova (1968), Heil et. Af.,(1972), etat,(1973) and Slight», (1996 6) \vim* reported that, the low doses of carbaryl was slight irregularity in the arrangement of spermatogenic cell layers. However high dose of carbaryl caused marked destruction of spermatogenic cell layer with appearance of vacuoles inside cytoplasm. They also added that there were decrease in spermatogenesis and change in sperm function and fertility was impaired.

The effect of carbaryl on testis were not fully clear until now, however it might be attributed to a direct cytotoxic effect on seminiferous cells in view of degenerative and necrotic changes demonstrated in the spermatogenic tubules. Despite this explanation it might be due to an indirect effect of carbaryl on the blood vessels of testis which cause vascular stasis or it might be due to inhibition of overall hormonal control mechanism at either the gonadal or hypothalamic pituitary levels.

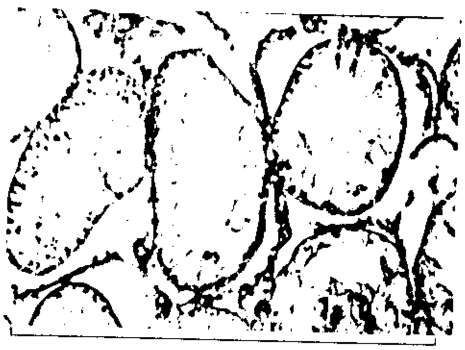
As a result of the obtained finding through this investigation, it can be recommend that careful handling and proper use of carbaryl. Also the application of carbaryl must be predicted on selected quantities and manners of usage, which minimize the possibilities of exposure of man and animals to injurious hazards carbaryl.

(a) A photomicrograph of normal testis section of adult albino rat the control group showing: Normal histopathological pattern pfxanmihrovs tubules and interstitial cells in between tubules. the lumen of tubules filled with spermatozoa. *(Themafarylin & Eosin X 250)*



(b) *Fig. (34):* A photomicrograph of testis section of adult albino rat of the first group showing: Mild to moderate degree of degenerative changes in germinal layer of semlniferous tubules in the fonn of presence of vacuolation and irregular arrangement in the germinal layer. *(Hoemalarylin & Eosin X 400),I*

c) A photomicrograph of testis section of adult albino of the second group showing: Irregular in basement membrane. Moderate degree of degenerative changes in spennatogenic cells with beginning of appearance of spennatid giant cells. *(11aemaioxylin &* Each, *X 400)*



(d) A photomicrograph of testis.ection of adult albino rat of the third group showing: Sever degree of degenerative changes in the germinal layers of the seminiferous tubules with the presence of giant cell spennatid. Engorged blood vessels between tubules, *atucntatonlin & Eosin X 400).*

(e) A photomicrograph &testis section of adult albino rat of the recovery group showing: There was an increase in the cell layers within the tubules with the of huge number of immature sperms. Interstitial cells appear normal. *Inenaarylin & Eosin X 1000A*

Figure (3) Photomicrographs showing histopathologital effects of carbaryi on the testes of rats.