RESULTS

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Animal Observations :

Transient ataxia, hypoactivity and laboured respiration were observed in group III (exposed to 4 g/m^3 of unleaded gasoline vapor) throughout the eight weeks of exposure regiment. There were no animal death in all the experimental groups throughout the experimental period.

Body and Organ Weights :

Table (1) presents the mean body weights and % weight gains post 8 weeks of unleaded gasoline exposure. Figure (1) represents the percent of body gain for male albino rats exposed to unleaded gasoline vapor (growth curves). It was noted that at the end of the exposure regimen, % of body gain was decreased significantly in all treated groups compared to the respective control. The growth curves of control and unleaded gasoline exposed rats (Figure 1) also showed that rats exposed to unleaded gasoline vapor exhibited a retarded weight gain compared to the controls ones.

Table (2) summarize mean relative organ weights Fig. (2) provides relative organ weight data as percentage of the control. There were statistically significant and concentration related increases in the weight of testes and non significant increase in weights of lung. While there were no significant decrease in weights of both liver and spleen. On the other hand there was no significant change for weights of kidney in all treated groups compared to control.

Table (1) : Body weights and % weight gains of male albino rats exposed to three levels of unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4 h / day, 5 days/week) for eight weeks :

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)
Initial body weights (g)	130.8 ± 0.38	155.8 ± 5.10	138.2± 6.40	139.9 ± 4.20
Final body weight	239.6 ± 8.85	247.1 ± 6.96	236.7 ± 6.50	221.3 ± 4.80
% weight gains after 8 weeks	80.1 ± 2.40	58.8^{a**} ± 1.70	72.2^{a*b**} ± 3.50	58.4^{a***bc**} ± 2.30

Values expressed as mean ± standard error

* = Significant difference at P < 0.05
** = Significant difference at P < 0.01
*** = Significant difference at P < 0.001

a= Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III

Table (2) : Relative organ weights of male albino rats exposed to three levels of unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4 h / day, 5 days/week) for eight weeks.

Group / Exposure Dose / Organs	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
Liver	2.83 ± 0.08	2.67 ± 0.08	2.65 ± 0.06	2.51 ± 0.11	N.S
Kidney	0.60 ± 0.03	0.61 ± 0.03	0.60 ± 0.01	0.60 ± 0.02	N.S
Testes	0.80 ± 0.08	0.98^{a} ± 0.08	1.10^{a***b} ± 0.08	1.00^{a*bc} ± 0.08	*
Lung	0.62 ± 0.04	0.73 ± 0.06	0.69 ± 0.04	0.71 ± 0.04	N.S
Spleen	0.27 ± 0.03	0.22 ± 0.02	0.21 ± 0.01	0.23 ± 0.02	N.S

Values expressed as mean ± standard error

* = Significant difference at P < 0.05
*** = Significant difference at P < 0.001

a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III

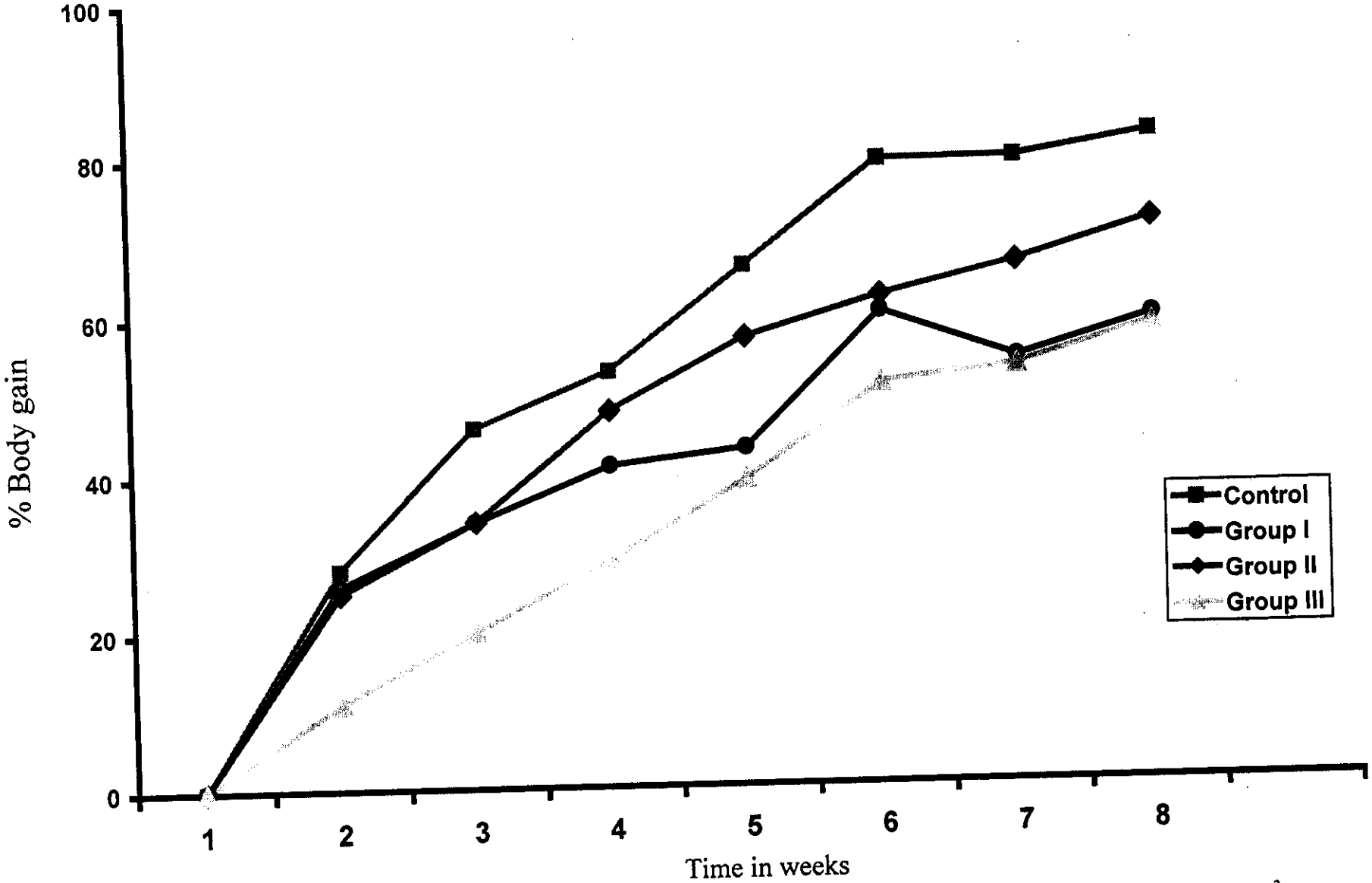


Fig. (1) : % Mean body gain of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, II and III respectively) for 4 h/day, 5 days/week for eight weeks.

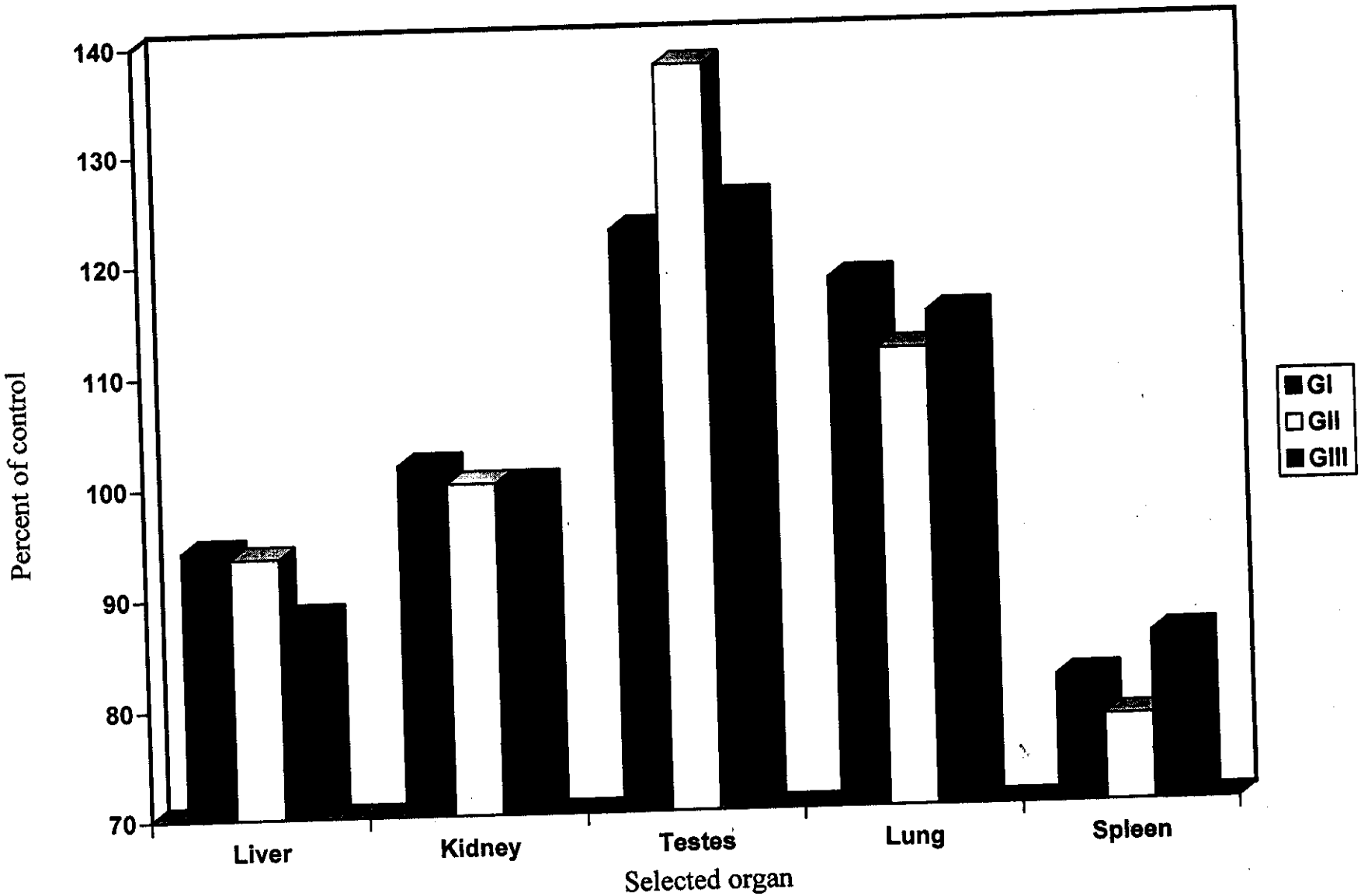


Fig. (2) : Relative organ weights (relative to body weight) as expressed as % of control of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

Blood parameters :

[1] Hemoglobin contents :

The hemoglobin (Hb) contents showed significant declines after inhalation of unleaded gasoline in all treated animal groups compared to the control group (Table 3 and Fig 3a). These decreases were gradual with percentages of 13.4, 17.2 and 18.7 for group I, group II and group III, respectively versus the control group. There were no significant changes in Hb contents among the treated animal groups.

[2] Total erythrocyte count :

It is obvious from the present study that unleaded gasoline inhalation was implicated in the decrease of RBCs count (Table 3 & Fig. 3b). The RBCs count were decreased significantly in all treated animal groups compared to the control group. These decreases were gradual with percentages of 14.9, 23 and 31.1 for group I, group II and group III, respectively, versus the control group. Among the three treated groups there was only a significant decline in RBCs count in animals of group III compared to that of group I.

[3] Total leucocyte count :

The WBCs count showed non significant decreases in treated animal groups compared to the control group (Table 3 & Fig. 3c).

The differential count of leucocytes indicated significant increases of neutrophils in all treated animal groups compared to the control group (Table 3 & Fig. 4a). There were significant decreases in lymphocyte numbers in all treated animal groups compared to the control group (Table 3 & Fig. 4b). The number of monocytes, eosinophiles and basophils in treated animal groups showed non significant changes compared to the control group (Table 3 and Fig. 4c,d,e).

Table (3) : Blood parameters of male albino rats exposed to three levels of unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4 h / day, 5 days/week) for eight weeks.

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
Hb (g/100 ml)	13.4 ± 0.4	11.6^{a**} ± 0.5	11.1^{a***b} ± 0.3	10.9^{a***bc} ± 0.3	***
RBCs (number × $10^6/mm^3$)	7.4 ± 0.4	6.3^{a*} ± 0.2	5.7^{a***b} ± 0.3	$5.1^{a***b**c}$ ± 0.2	***
WBCs (number × $10^3/mm^3$)	7.7 ± 1.1	5.8 ± 0.5	5.5 ± 0.3	6.7 ± 0.6	N.s
Neutrophils	31.6 ± 2.6	42.4^{a**} ± 1.6	38.6^{a*b} ± 2.5	39.0^{a*bc} ± 1.9	*
Lymphocyte	65.9 ± 1.2	52.7^{a***} ± 2.2	57.5^{a**b} ± 2.5	55.0^{a**bc} ± 3.6	**
Monocyte	3.0 ± 0.4	2.3 ± 0.3	2.3 ± 0.3	2.7 ± 0.3	N.S
Eosinophil	1.7 ± 0.1	2.1 ± 0.6	1.3 ± 0.3	1.7 ± 0.2	N.S
Basophil	0.7 ± 0.3	0.4 ± 0.2	0.6 ± 0.3	0.6 ± 0.2	N.S

Values expressed as mean ± standard error

* = Significant difference at P < 0.05
** = Significant difference at P < 0.01
*** = Significant difference at P < 0.001

a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III

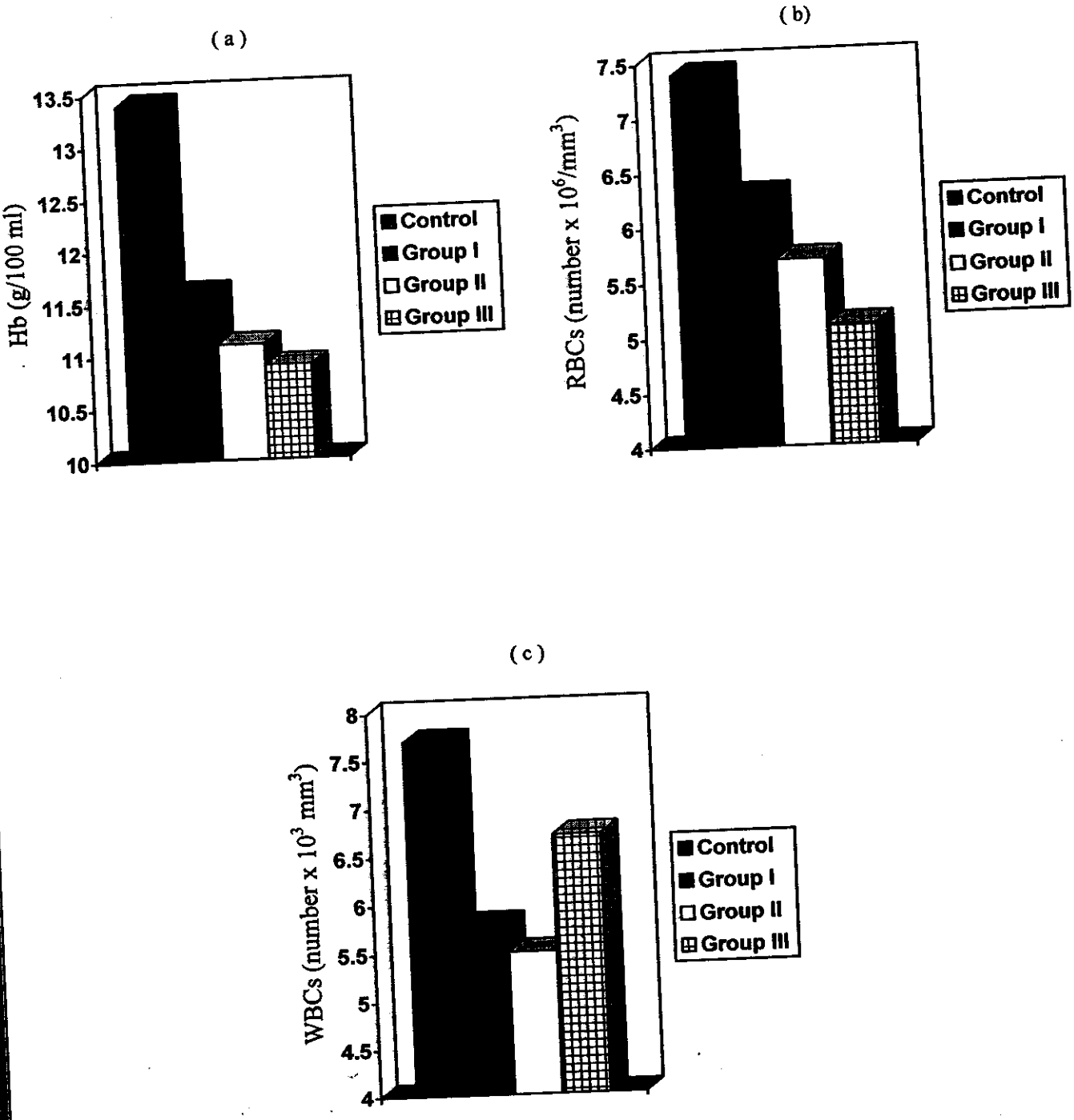


Fig. (3) : The hemoglobin (Hb) contents (a), RBCs count (b) and WBCs count (c) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

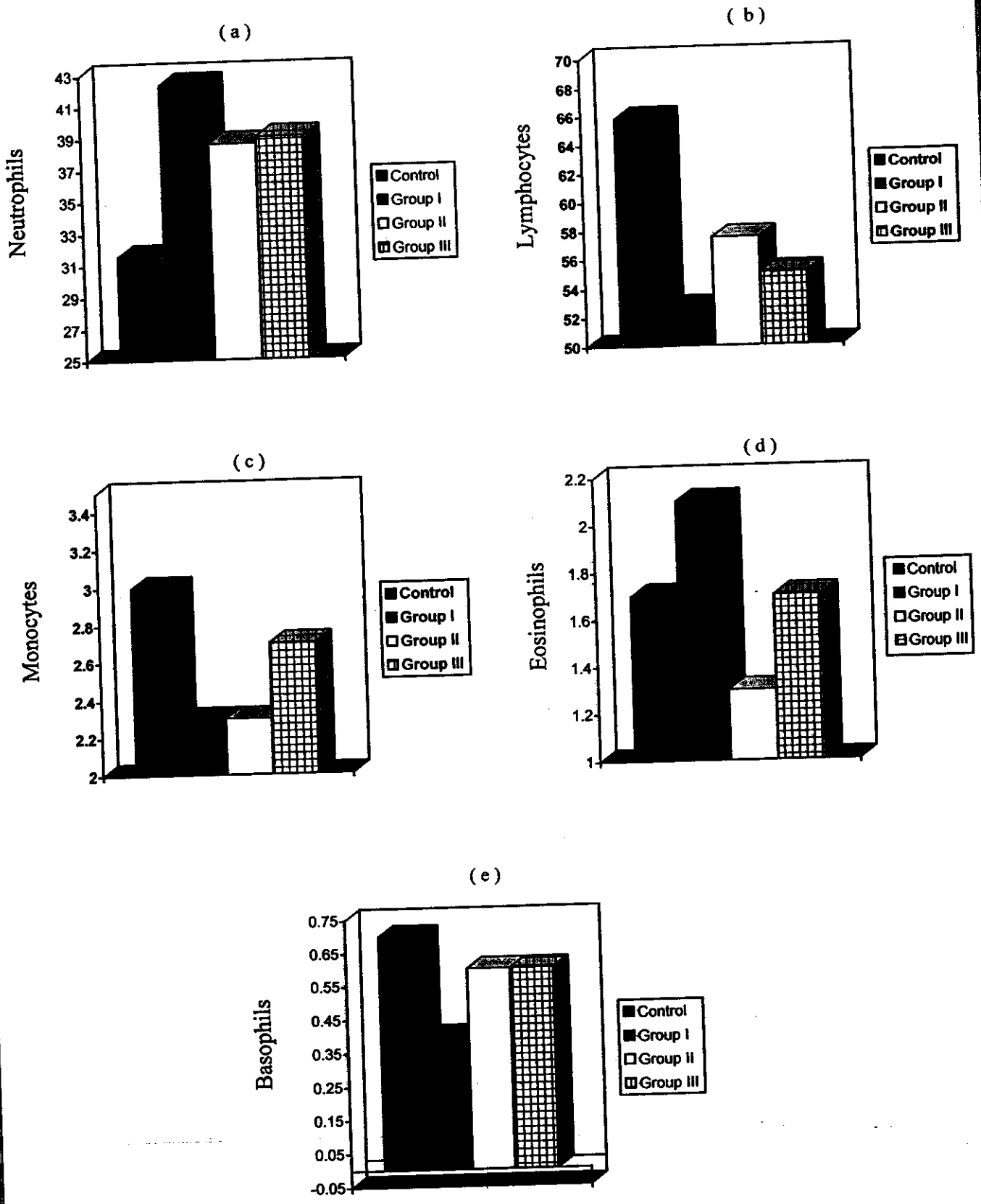


Fig. (4) : The neutrophile count (a), lymphocyte count (b), monocyte count (c), eosinophil count (d) and basophil count (e) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

Blood Gase Parameters

[1] Oxygen partial pressure (PO_2) :

The results presented in table (4) and fig. (5) showed that both arterial and venous oxygen partial pressures (P_aO_2 and P_vO_2) of the three treated animal groups were non significantly higher than those of the control one. Arterio-venous differences, alveolar and alveolar-arterial differences for oxygen partial pressures ($P_{a-v}O_2$, P_AO_2 and $P_{A-a}O_2$ respectively) were differently affected by inhalation of unleaded gasoline. The $P_{a-v}O_2$ was increased significantly and non-significantly in animals of group II and both group I and group III, respectively. The highest level of $P_{a-v}O_2$ was recorded for animals of group II which was significantly high compared to any other groups. The P_AO_2 was significantly and non significantly increased in animals of both groups I and III and of group II, respectively compared to the control group. The highest increase in P_AO_2 was recorded in animals of group III. The P_AO_2 values for animals of both group I and group III were significantly higher compared to that of group II. The $P_{A-a}O_2$ was non-significantly increased in animals of both group I and group II, while it was non significantly decreased in animals of group III compared to that of the control group. $P_{A-a}O_2$ in animals of group III was significantly lower than those of animals of both group I and group II. The percentage venous admixture (% shunt) values for animals of group I and group II were non-significantly and significantly higher compared to that of the control group respectively, while that for animals of group III was non-significantly and significantly lower than those of control group and both group I and group II, respectively.

[2] Percentage oxygen saturation (% O2 sat) :

There were non-significant changes for arterial blood % O_2 saturation pressure values (%O_2 sat) in all treated animal groups compared to the control one. Venous blood % O_2 sat values of both group I and group II were non-significantly higher than that of the control group. It was significantly higher in group II than those of both the control group and group I. The (a-v) difference of %O_2 sat was non-significantly lower in all treated animal groups compared to that of the control one (Table 4 & Fig. 6).

[3] Carbon dioxide partial pressure (PCO_2) :

There were significant decreases in arterial blood PCO_2 (P_aCO_2) in both group I and group III with respect to the control one, while it was a non significantly decreased in group II. P_aCO_2 values in both group I and group III were significantly lower than that of group II. The venous blood PCO_2 (P_vCO_2) values of both group I and group III were significantly low, while that of group II was non significantly low compared to that of the control group. $P_{a-v}CO_2$ value was non significantly high in both group I and group II, while it was non significantly low in group III compared to that of the control group. (Table 4 & Fig. 7).

Blood Acid-Base Status Parameters :

Table (5) and Figs. (8-11) illustrate the effect of unleaded gasoline vapor inhalation on acid-base status parameters of male albino rats.

Table (4) : Blood gas prameters of male albino rats exposed to three levels of unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4 h/day, 5 days / week) for eight weeks.

Group		Control	Group I	Group II	Group III	"F"
Parameter \ Exposure Dose		(0 g/m^3)	($1g/m^3$)	($2g/m^3$)	($4g/m^3$)	
PO_2 mmhg	a	99.4 ± 1.4	100.9 ± 1.7	104.0 ± 10.9	111.3 ± 0.3	N.S
	v	26.1 ± 0.9	29.6 ± 3.9	35.9 ± 4.1	30.9 ± 2.6	N.S
	a-v	73.3 ± 0.5	79.0^{a} ± 7.4	105.6^{a**b*} ± 13.4	80.4^{abc*} ± 2.9	*
	A	113.4 ± 1.2	120.3^{a**} ± 0.9	113.8^{ab***} ± 2.8	$122.0^{a**bc***}$ ± 1.2	***
	A-a	14.0 ± 1.9	18.9^{a} ± 1.1	18.5^{ab} ± 1.9	10.7^{ab**c*} ± 1.3	**
	%shunt	16.2 ± 2.0	21.0^{a} ± 1.4	28.0^{a**b} ± 3.3	$11.4^{ab*c***}$ ± 0.3	***
$\%O_2$ sat	a	97.7 ± 0.1	97.7 ± 0.4	91.71± 4.5	98.2 ± 0.1	N.S
	v	43.0 ± 1.7	45.5^{a} ± 6.8	65.7^{a**b*} ± 5.4	51.0^{abc} ± 4.9	*
	a-v	54.8 ± 1.7	52.2 ± 7.0	34.7 ± 4.8	47.1 ± 4.9	N.S
PCO_2	a	35.7 ± 1.0	30.1^{a**} ± 0.7	35.4^{ab**} ± 2.2	$28.6^{a**(b)c}$ ± 1.1	***
	v	48.3 ± 0.9	39.0^{a*} ± 1.4	45.9^{ab*} ± 3.1	42.1^{a*bc} ± 2.0	*
	a-v	- 12.6 ± 1.9	- 9.7 ± 1.2	- 7.9 ± 3.6	- 14.6 ± 1.7	N.s

Values expressed as mean ± standard error

* = Significant difference at $P < 0.05$
** = Significant difference at $P < 0.01$
*** = Significant difference at $P < 0.001$
a = Arterial
v = Venous
a – v = Arterio – venous difference
a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III
A = Alveolar capillary blood
A – a = Alveolo – arterial difference

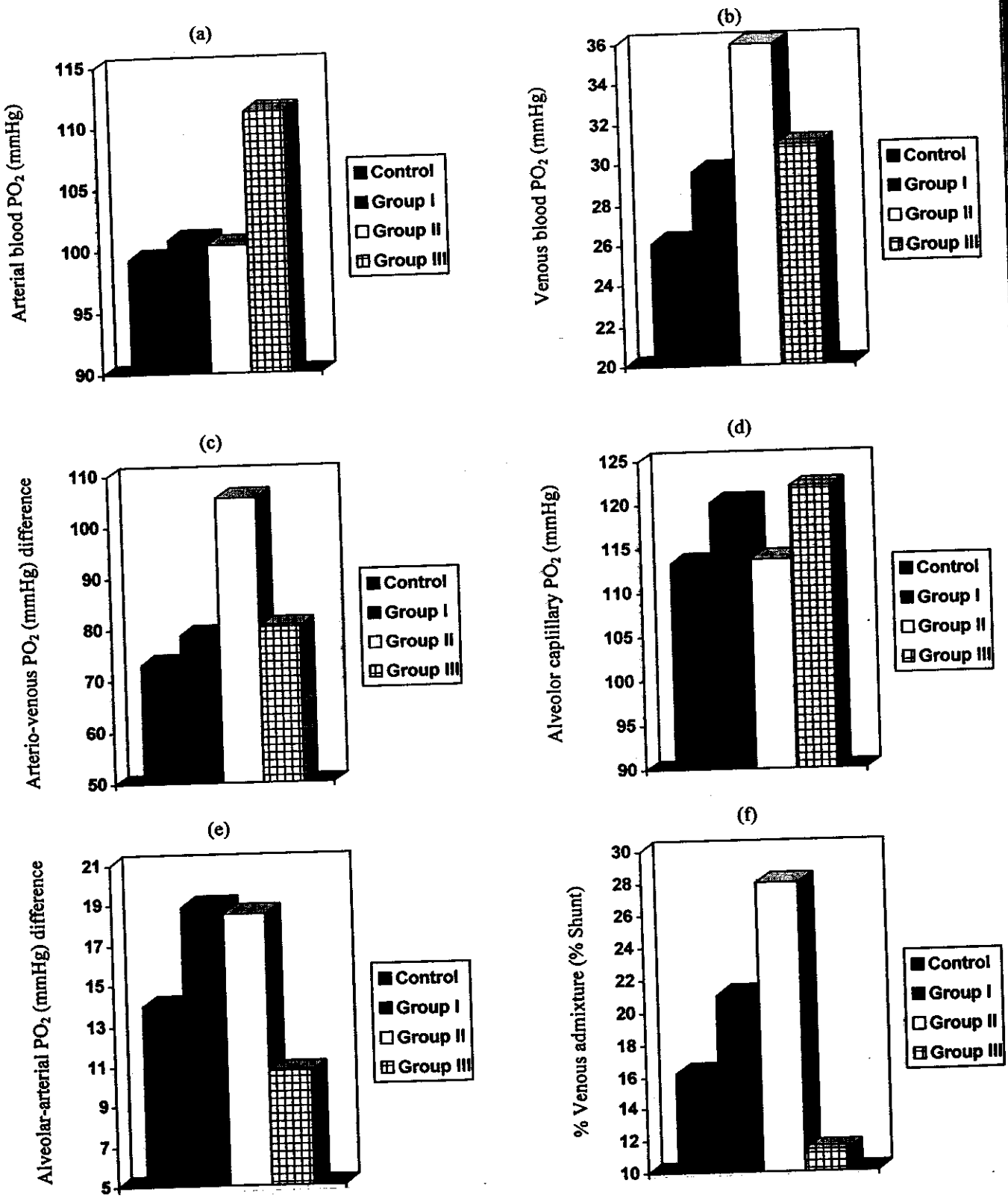


Fig. (5) : Blood oxygen partial pressures in mmHg (a: arterial, b: venous, c: arterio-venous difference, d: alveolar, e: alveolar-arterial difference) and percentage of venous admixture (f) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

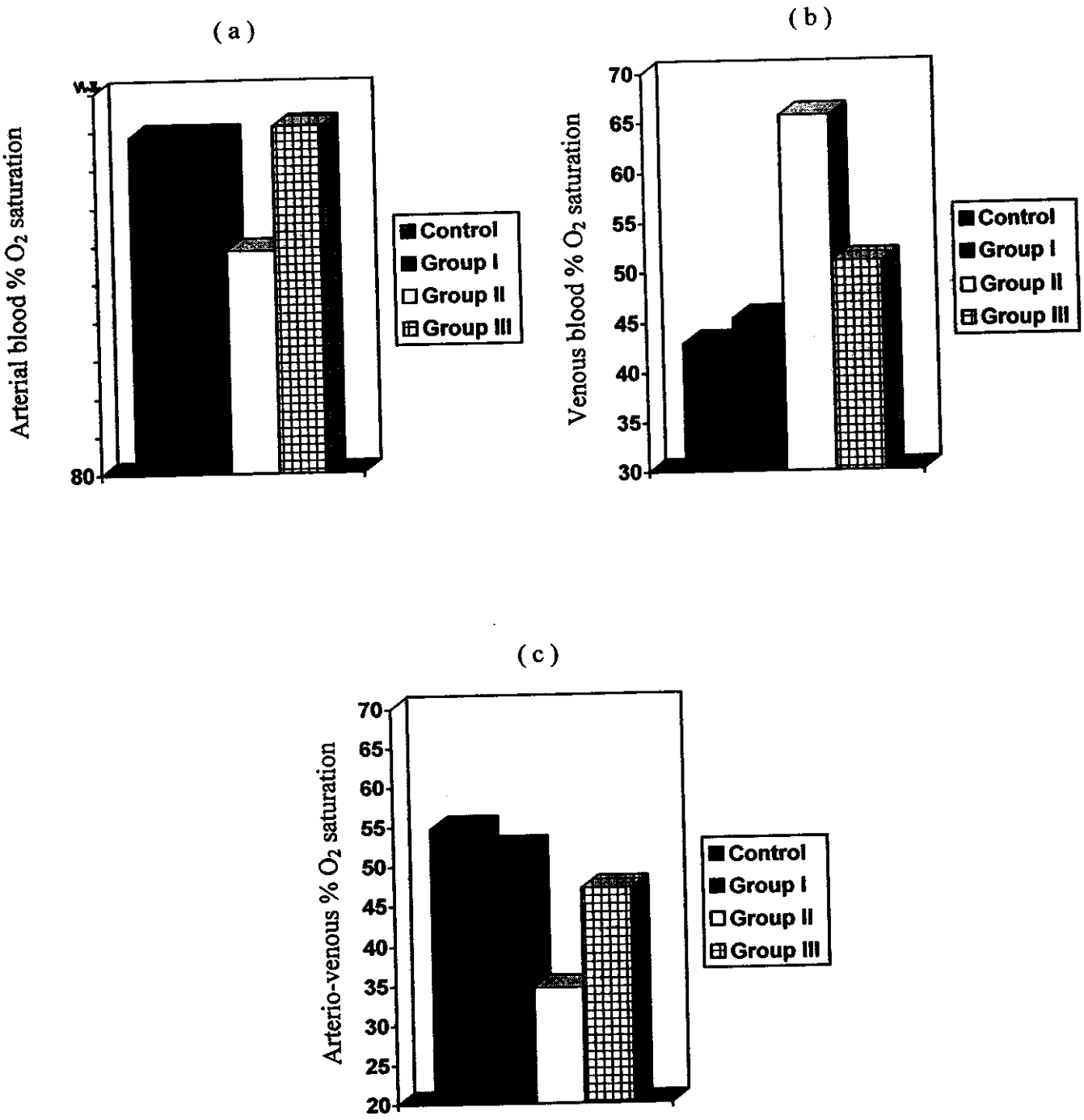


Fig. (6) : Blood % O_2 saturation (a: arterial, b: venous, c: arterio-venous difference) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

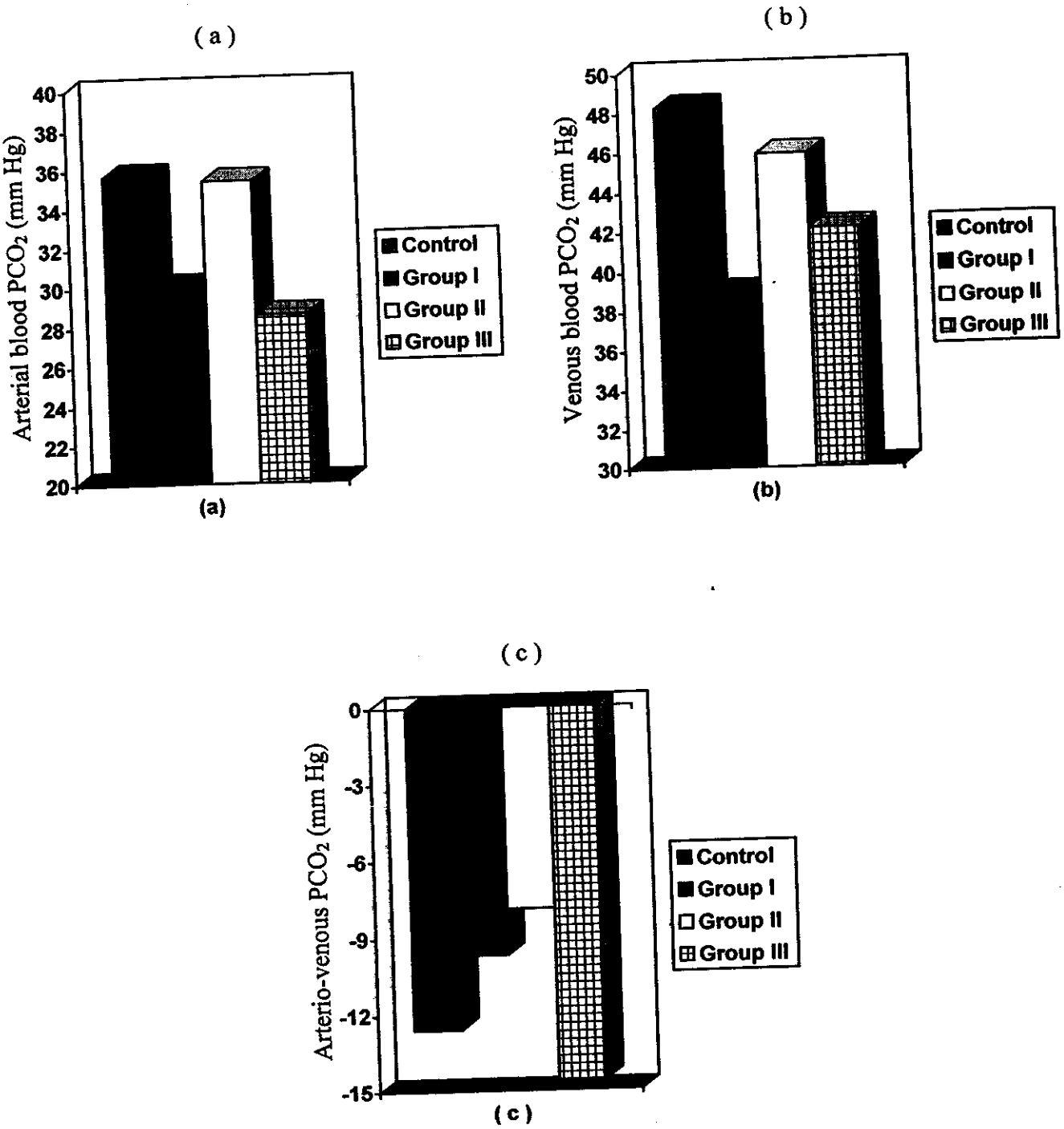


Fig. (7) : Blood carbon dioxide partial pressures in mmHg (a: arterial, b: venous, c: arterio-venous difference) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively)for 4h/day, 5 days/week for eight weeks.

[1] pH :

The data presented in Table (5) and Fig. (8) showed reduction in arterial blood pH values in all treated animal groups compared to that of the control group. These reductions in pH values were only significant in group II compared to both that of control group and those of the other treated groups. Venous blood pH values were non significantly higher in both group I and group III than that of the control group, while that of group II was non significantly changed. The (a-v) difference of pH values of both group I and group III were non significantly lower than that of the control group, while that of group II was significantly lower than that of both control group and the other treated groups (group I and group III).

[2] Bicarbonate concentration (HCO^-_3) :

The results presented in Table (5) and Fig. (9) showed that arterial blood HCO^-_3 concentration values of all treated groups were significantly lower than that of the control group. There were non significant differences among the treated groups. Venous blood HCO^-_3 concentration values of both group I and group III were non significantly lower than that of the control group, while that of group II was non significantly higher than that of the control group. The (a-v) values of HCO^-_3 concentration of all treated groups were non-significantly lower than that of the control one.

[3] Total carbon dioxide (TCO2) :

Table (5) and Fig. (10) showed that arterial blood TCO_2 values of all treated groups were lower than that of the control group, the decline was significant in both group I and group III. Venous blood (TCO_2) values of both group I and group III were significantly lower than those of control group and group II. The (a-v) value of (TCO_2) was non significantly low in both group II and group III compared to that of the control group, while that of group I was non significantly higher than that of the control group.

[4] Base excess (BE) :

Table (5) and Fig. (11) showed that arterial blood base excess(BE) values of both group I and group III were significantly lower than that of the control group, while that of group II was non significantly lower than. There were non-significant changes among the treated groups. Venous blood BE values were significantly and non significantly lower in group I and group III, respectively than that of control group, while in group II it was non significantly and significantly higher than that of the control group and those of the other treated groups respectively. The (a-v) BE values of all treated groups were non-significantly lower than that of the control group.

Table (5) : Blood acid-base status parameters of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4 h/day, 5 days / week) for eight weeks.

Group		Control	Group I	Group II	Group III	"F"
Parameter \ Exposure Dose		(0 g/m^3)	(1g/m^3)	(2g/m^3)	(4g/m^3)	
pH (unit)	a	7.45 ± 0.004	7.43^{a} ± 0.02	$7.33^{a***b**}$ ± 0.030	7.41^{abc**} ± 0.010	**
	v	7.34 ± 0.005	7.38 ± 0.020	7.34 ± 0.020	7.37 ± 0.002	N.S
	a-v	0.09 ± 0.010	0.08^{a} ± 0.020	0.01^{a**b**} ± 0.020	0.06^{abc*} ± 0.010	**
HCO^{-}_3 (mmol/L)	a	25.30 ± 0.500	22.50^{a*} ± 1.000	22.70^{a*b} ±0.900	22.40^{a*bc} ±0.600	*
	v	23.40 ± 0.700	21.30 ± 0.700	23.60 ± 0.080	22.00 ± 0.700	N.S
	a-v	1.97 ± 0.980	1.10 ± 1.400	- 0.90 ± 0.090	0.40 ± 0.200	N.S
TCO_2 (mmol/L)	a	25.10 ± 0.700	21.30^{a*} ±1.100	24.30^{ab} ± 1.500	20.80^{a*bc*}±0.700	*
	v	27.70 ± 0.900	23.70^{a*} ± 0.500	27.60^{ab*} ± 1.100	24.10^{a*bc*}±1.300	*
	a-v	-2.60 ± 1.400	- 2.40 ± 1.400	- 3.20 ± 0.900	- 3.40 ± 0.700	N.S
BE (mmol/L)	a	0.35 ± 0.600	-3.70^{a**}±1.100	$- 1.60^{ab}$ ± 1.100	-3.60^{a**bc} ±0.600	*
	v	-1.20 ± 0.800	-4.40^{a*} ± 0.800	$- 0.30^{ab**}$ ± 0.800	0.03^{a**bc} ± 0.300	**
	a-v	1.60 ± 1.300	0.80^{a*} ± 1.700	$- 1.30^{ab**}$ ± 1.100	0.03^{abc*} ± 0.300	N.S

Values expressed as mean ± standard error

* = Significant difference at P < 0.05
** = Significant difference at P < 0.01
*** = Significant difference at P < 0.001
a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III
a = Arterial
v = Venous
a – v = Arterio – venous difference

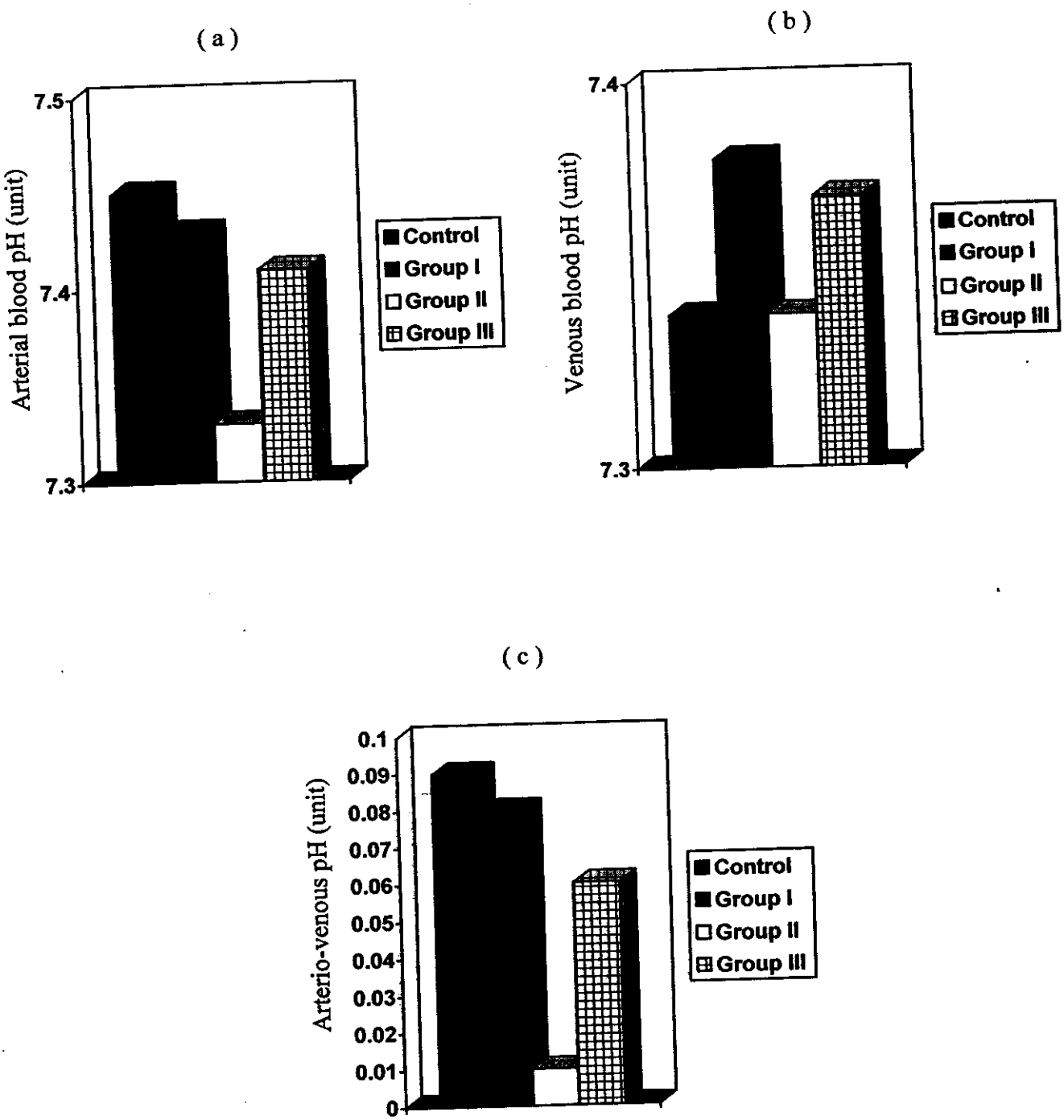


Fig. (8) : Blood pH values of (a: arterial, b: venous, c: arterio-venous different) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

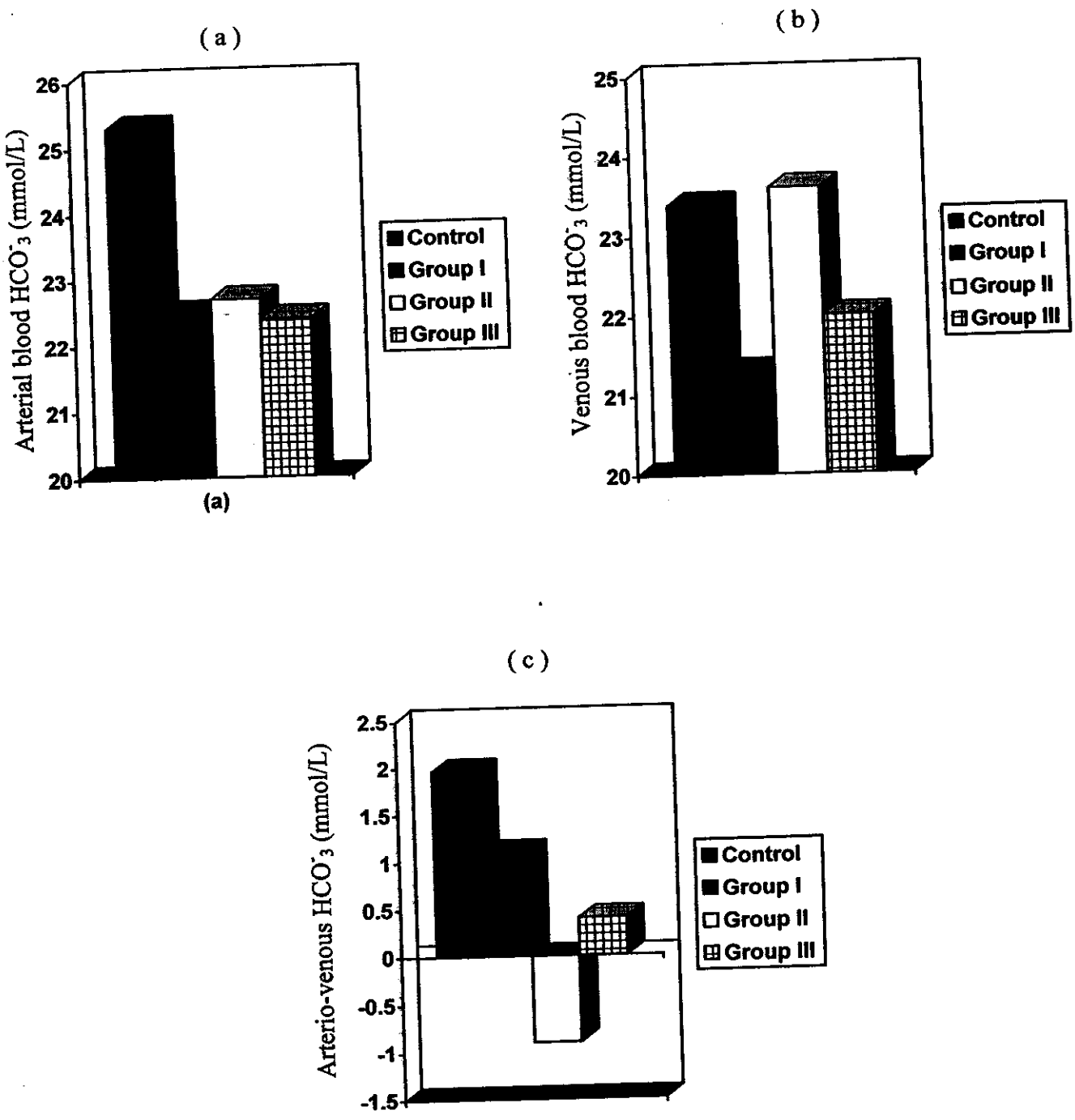


Fig. (9) : Bicarbonate concentration (HCO^-_3) in m mol/L (a: arterial, b: venous, c: arterio-venous difference) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

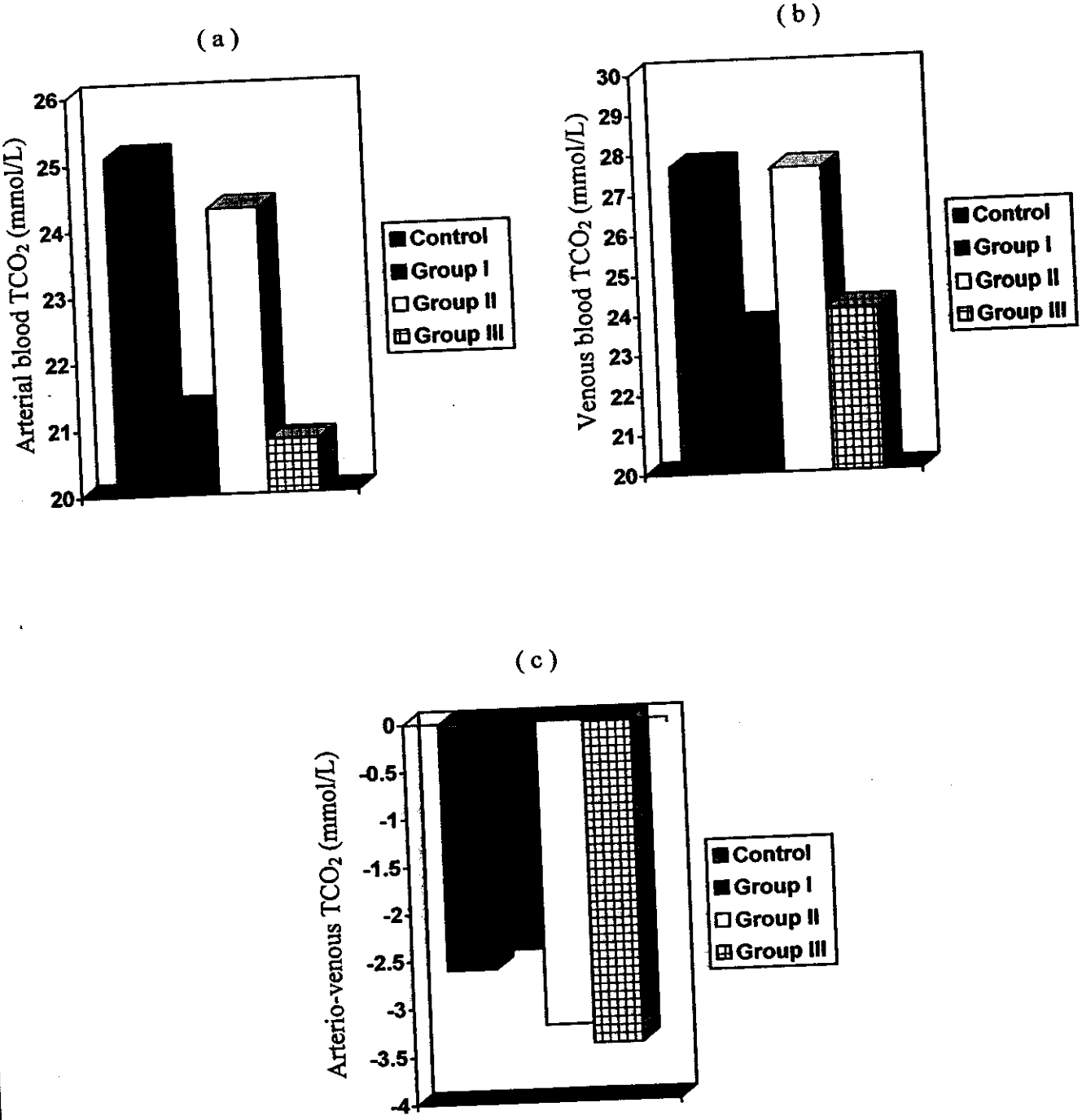


Fig. (10) : Total carbon dioxide (TCO_2) in mmol/L (a: arterial, b: venous, c: arterio-venous difference) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

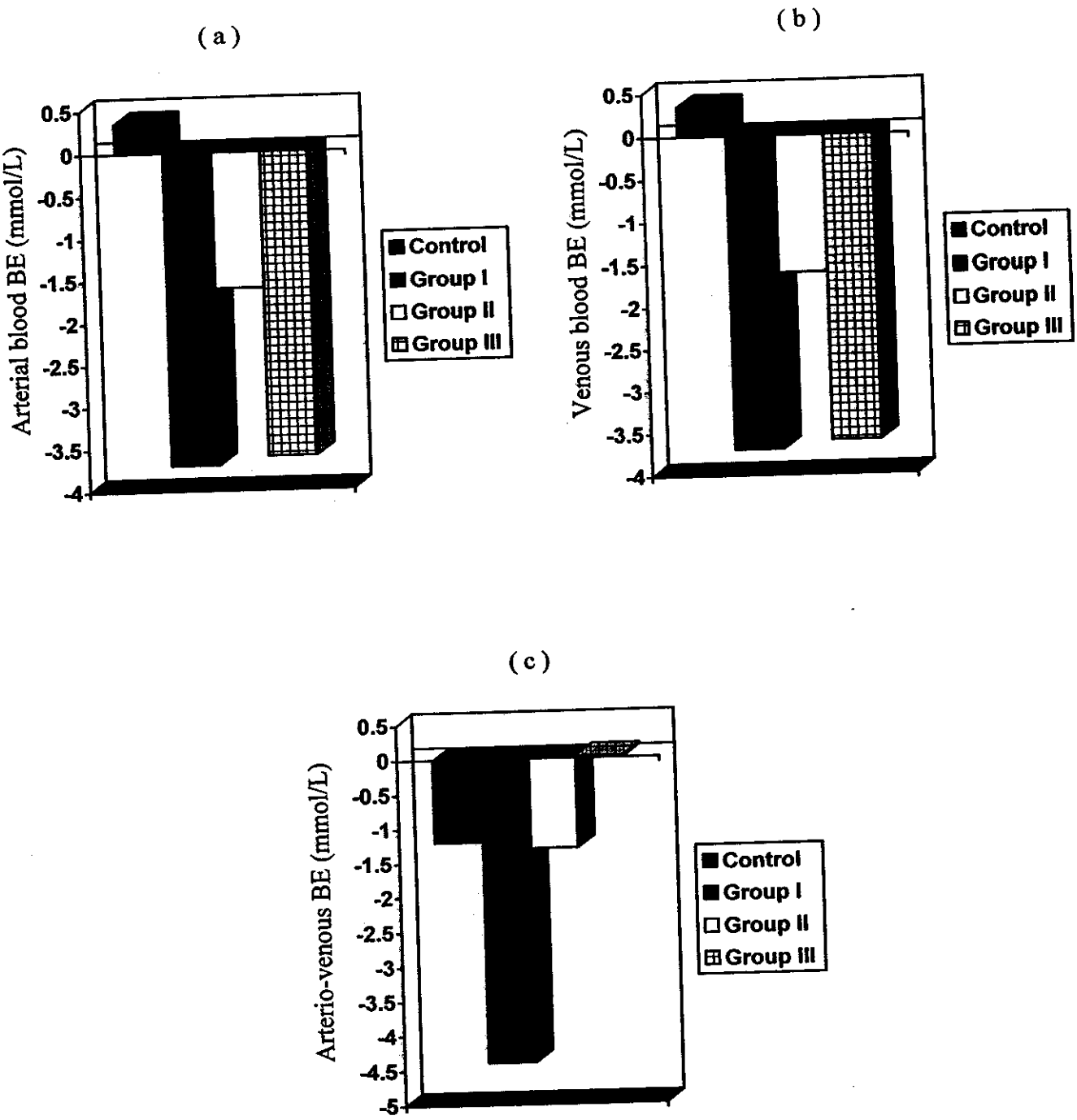


Fig. (11) : Base excess (BE) in mmol/L (a: arterial, b: venous, c: arterio-venous difference) of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

Blood Oxygen Equilibrium Curve (OEC) :

Fig. (12) showed that OECs of treated groups were found to be shifted to the left in relation to that of the control group. The blood oxygen half saturation pressure (P_{50}) as a measure of blood oxygen affinity found to be (29 ± 0.6), (27 ± 0.6), (28 ± 0.6) and (27.5 ± 0.3) in control, group I group II and group III, respectively with non significant differences between them (Table 6). Hill's constant (n value in Hill's equation) was found to be (2.93 ± 0.1), (2.9 ± 0.1), (2.5 ± 0.1) and (2.4 ± 0.08) for control, group I, group II and group III, respectively with non significant differences between them. (Table 6 and Fig. 13).

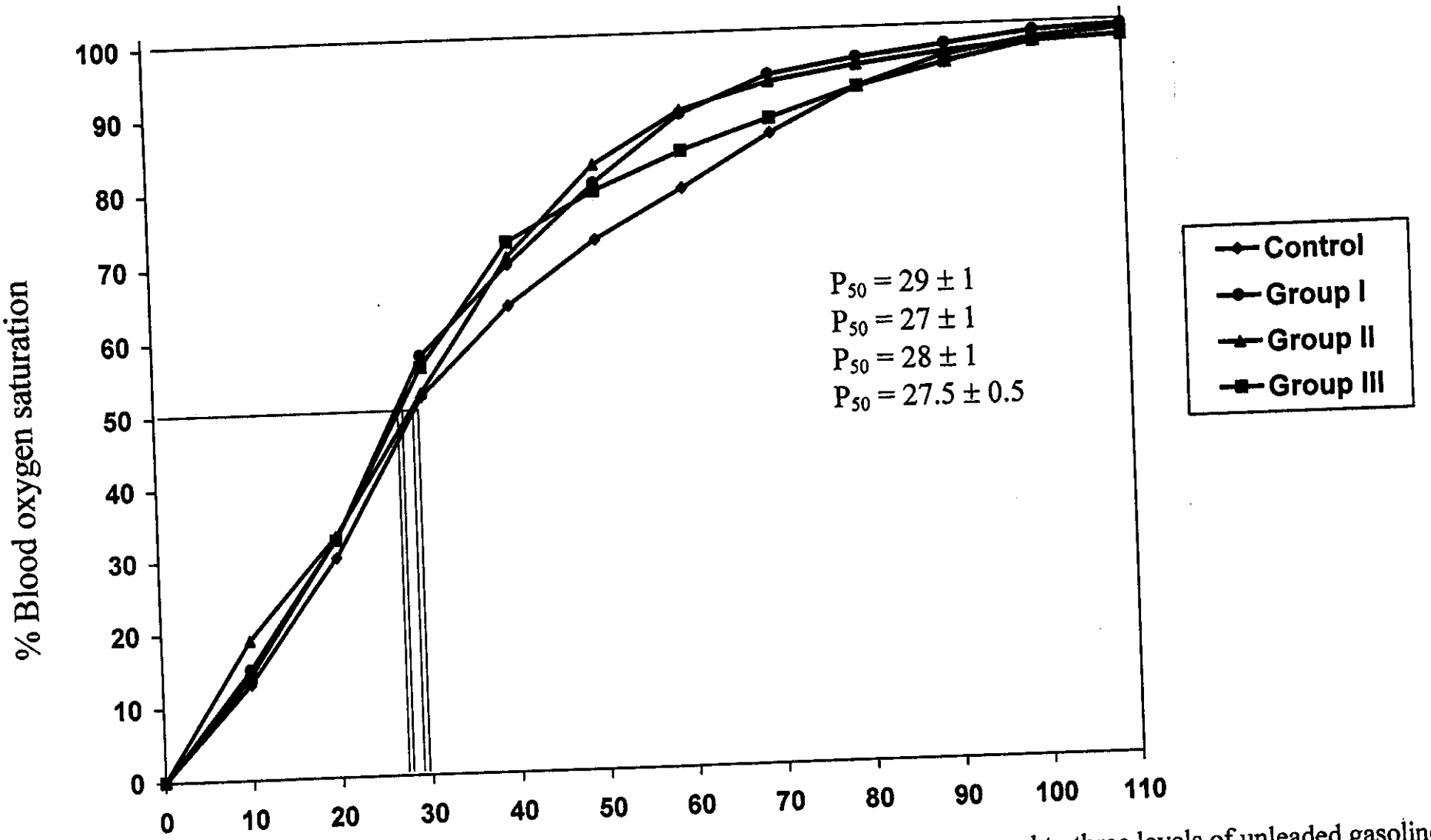


Fig. (12) : Blood oxygen equilibrium curves of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for h/day, 5 days/week for eight weeks.

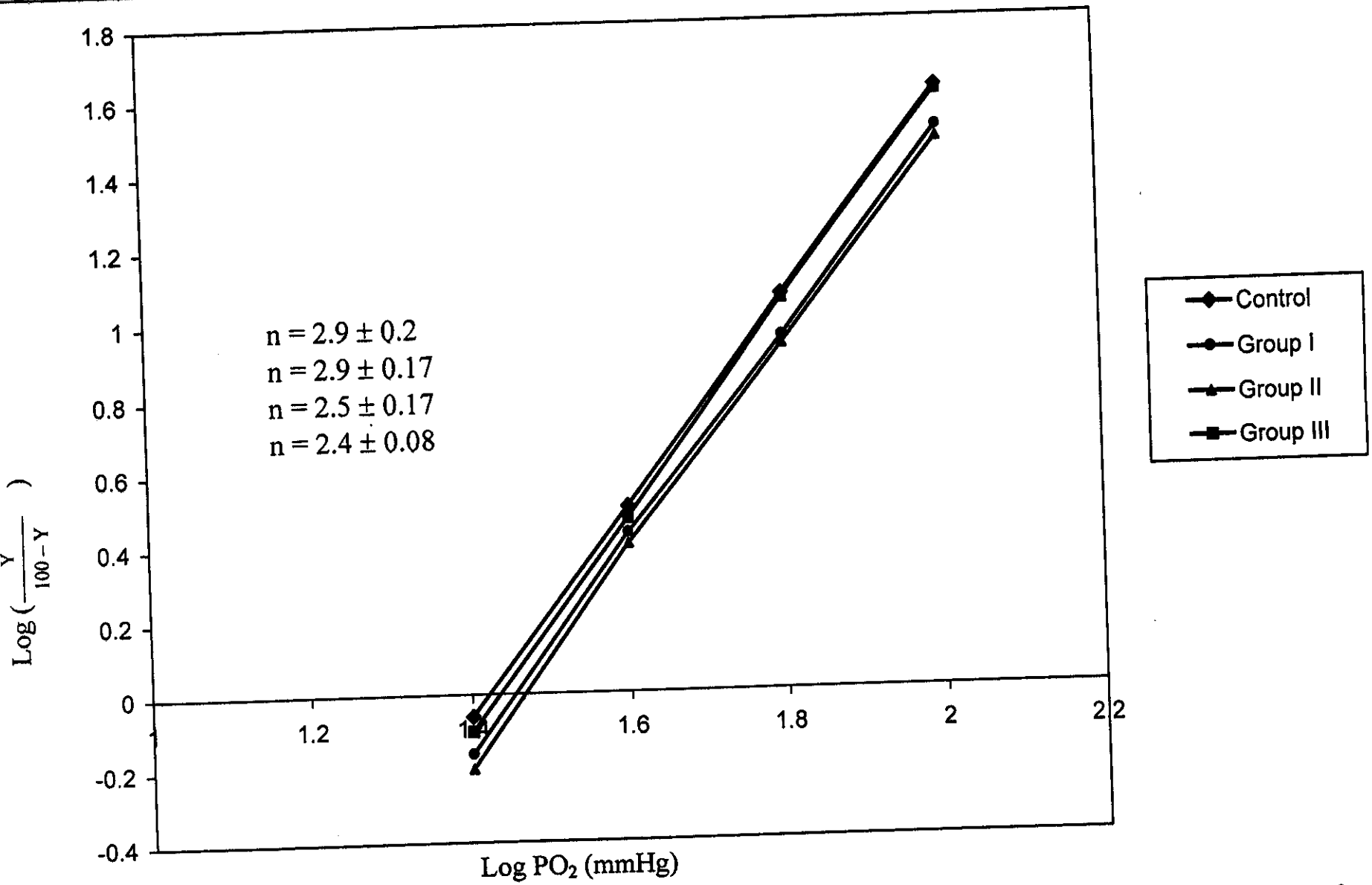


Fig. (13): Hill's plot of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

Y = %blood O_2 saturation

Table (6) : Blood oxygen half saturation pressure (P_{50}) and Hill's n value of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4 h/day, 5 days / week) for eight weeks.

Group	Control	Group I	Group II	Group III	"F"
Exposure Dose / Parameter	(0 g/m^3)	(1g/m^3)	(2g/m^3)	(4g/m^3)	
P_{50} (mmHg)	29.0 ± 0.6	27.0 ± 0.6	28.0 ± 0.6	27.5 ± 0.3	N.S
n	2.9 ± 0.1	2.9 ± 0.1	2.5 ± 0.1	2.4 ± 0.1	N.S

Values expressed as mean ± standard error
N.S = Non significant

Serum Levels of Liver Enzymes (Aspartate aminotransferase "AST" and Alanine Aminotransferase "ALT") :

The results presented in Table (7) and Fig. (14) showed that serum AST and ALT levels were affected by unleaded gasoline inhalation. The levels of AST revealed remarkable and significant increases in all treated groups compared to that of the control one. The percentages of these increases were 140.9, 202.9 and 110.2 for group I, group II and group III respectively. AST level for group III was non significantly and significantly lower than those for group I and group II respectively. The levels of ALT in all treated groups were non significantly higher than that of the control one.

Serum Levels of Urea and Creatinine :

Table (8) and Fig. (15a) illustrated the effect of unleaded gasoline inhalation on the levels of serum urea for male albino rats. A significant and non significant decline in the levels of serum urea were observed for group I and group III, respectively, while it was non significantly high in group II compared to that of the control group. The levels of serum urea in group I was significantly lower than those of both group II and group III.

The levels of serum creatinine were non significantly low in the three treated groups compared to that of the control group (Table 8 and Fig. 15b).

Table (7) : Serum levels of asparte amino transferase (AST) and alanine aminotrasferase (ALT) of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4 h/day, 5 days / week) for eight weeks.

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
AST (Unit/L)	13.7 ± 2.1	33.0^{a*} ± 2.9	41.5^{a***b} ± 3.4	28.8^{a*bc*} ± 4.8	***
ALT (Unit/L)	25.7 ± 1.1	26.6 ± 1.6	28.1 ± 0.5	28.7 ± 1.9	N.S

Values expressed as mean ± standard error

* = Significant difference at P < 0.05
*** = Significant difference at P < 0.001
a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III

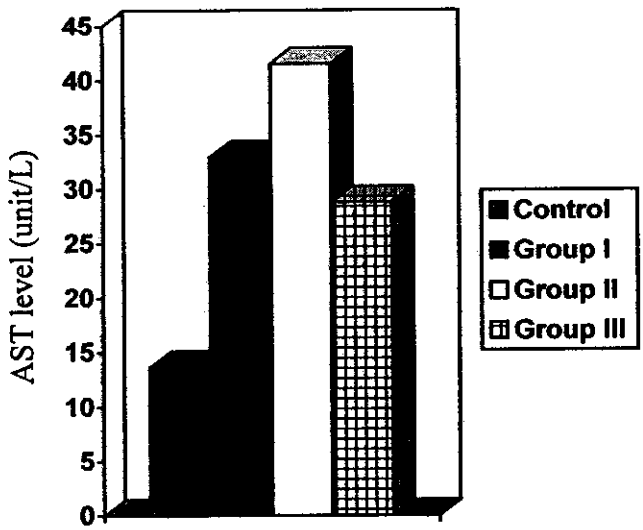
Table (8) : Serum levels of urea and creatinine of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4 h/day, 5 days / week) for eight weeks.

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
Urea (mg/dl)	10.60 ± 0.31	9.00^{a**} ± 0.30	10.70^{ab**} ± 0.40	10.20^{ab*c} ± 0.50	*
Creatinine (g/dl)	1.96 ± 0.08	1.89 ± 0.04	1.85 ± 0.04	1.82 ± 0.04	N.S

Values expressed as mean ± standard error

* = Significant difference at P < 0.05
** = Significant difference at P < 0.01
a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III

(a)



(b)

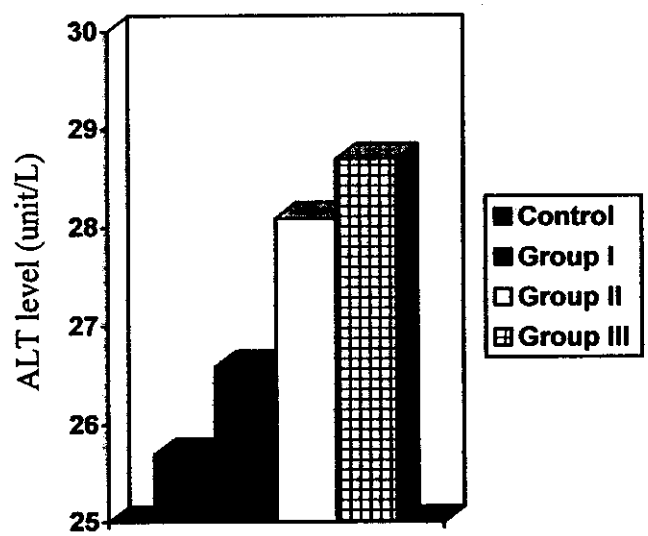


Fig. (14) : The levels of aspartate aminotransferase; AST (a) and alanine aminotransferase, ALT (b) activities in serum of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

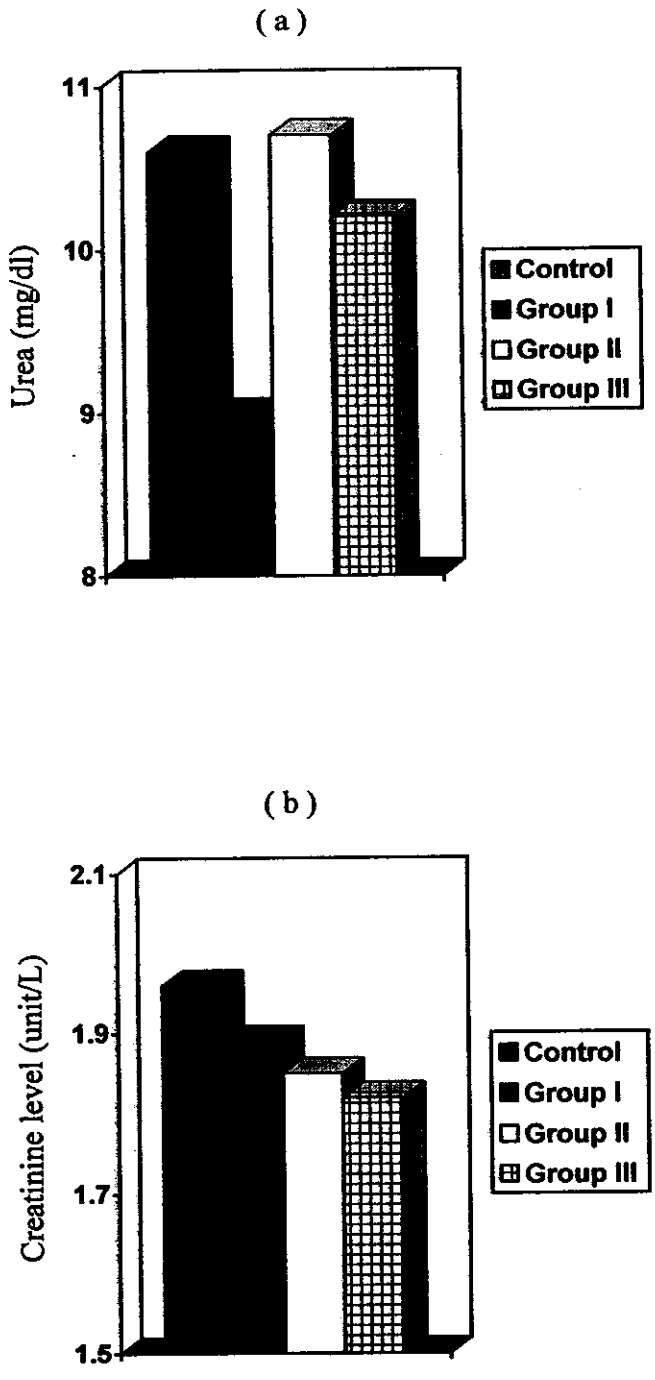


Fig. (15) : The levels of urea (a) and creatinine (b) in serum of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

Serum Levels of Cholinesterase :

The data presented in Table (9) and Fig. (16) showed that the levels of cholinesterase in sera of rats exposed to unleaded gasoline vapor were non significantly high compared to that of the control group.

Serum Levels of Immunoglobuline G (IgG) :

The data presented in Table (10) and Fig. (17) showed that the serum levels of IgG of animal groups treated with unleaded gasoline vapor were non significantly low compared to that of the control group.

Table (9) : Serum levels of cholinesterase of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4h/day, 5 days / week) for eight weeks.

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
Cholinesterase (U/L)	1075.0 ± 35.6	1071.0 ± 41.8	1147.5 ± 33.6	1114.0 ± 59.8	N.S

Values expressed as mean ± standard error

N.S = non significant

Table (10) : Serum levels of immunoglobulin G (IgG) of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4h/day, 5 days / week) for eight weeks.

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
IgG (g/l)	39.1 ± 1.2	37.1 ± 1.0	36.7 ± 1.0	36.1 ± 1.0	N.S

Values expressed as mean ± standard error

N.S = Non significant

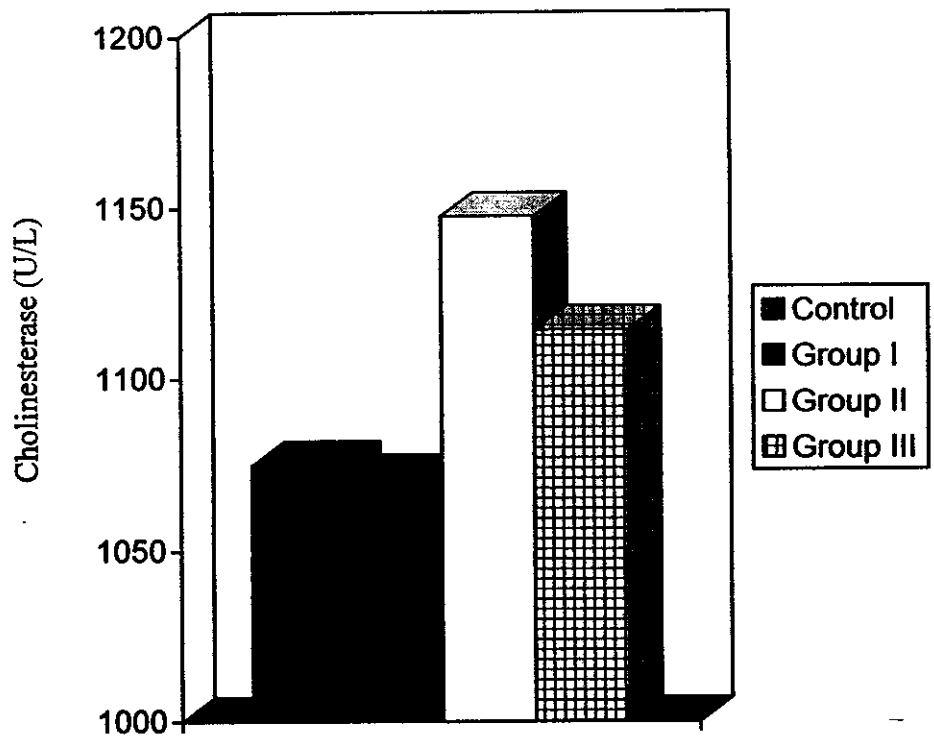


Fig. (16) : Cholinesterase (U/L) in serum of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

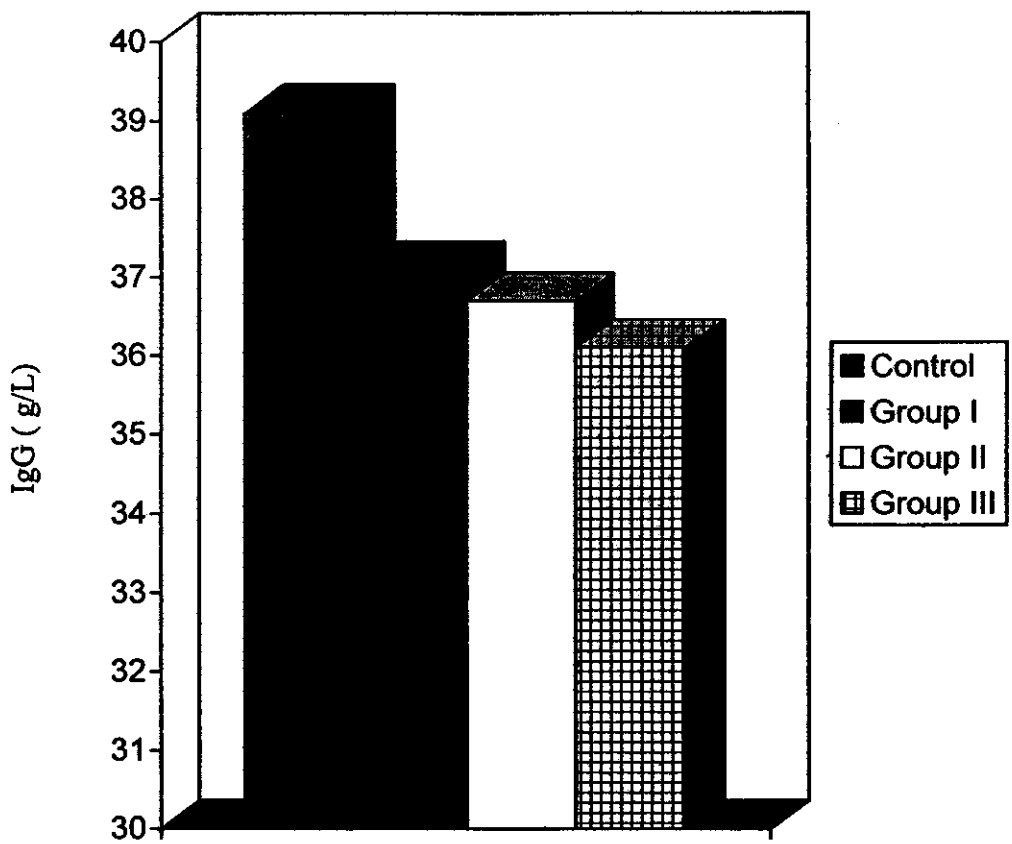


Fig. (17) : The levels of immunoglobuline G IgG (g/L) in serum of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

Serum Levels of Corticosterone :

Estimation of serum corticosterone of rats exposed to unleaded gasoline vapor (Table 11 and Fig. 18) showed marked and significant increases in its level compared to that of the control group. The percentage of these increases were 49.7, 50.8 and 82.5 for group I, group II and group III, respectively. No significant changes were observed between serum corticosterone levels of treated groups.

Serum Levels of Thyroxine (T_4) and Triiodothyronine (T_3) :

The serum levels of both T_4 and T_3 were affected by unleaded gasoline inhalation as observed in the data recorded in Table (12) and Fig. (19). The levels of thyroxine were increased significantly in both group I and group II, while the increase in group III was non significant compared to that of the control one. These increases were 16.6, 19.8 and 12.3 of that of the control group in group I, group II and group III, respectively. Non significant changes were observed between the treated groups. Conversely to the T_4 levels, the T_3 levels showed significant declines in both group II and group III, while the decline in group I was non significant with respect to the control one. The maximum decline was observed in group II with a percentage of 28.7%. T_3 level in group II was significantly and non significantly lower than those of group I and group III, respectively.

Serum Levels of Testosterone :

Table (13) and Fig. (20) illustrated the effect of unleaded gasoline exposure on the serum levels of testosterone. Significant decreases were observed in all treated groups

compared to the control one. The maximum decline was observed in group III with a percentage of 63.2%. The level of serum testosterone of group III was significantly and non significantly lower than those of group II and group I respectively.

Table (11) : Serum levels of corticosterone of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4h/day, 5 days / week) for eight weeks.

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
Corticosterone (ng/ml)	109.6 ± 12.3	164.1^{a**} ± 9.7	165.3^{a**b} ± 10.8	200.6$^{a***b\,c}$ ± 18.0	***

Values expressed as mean ± standard error

** = Significant difference at P < 0.01
*** = Significant difference at P < 0.001
a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III

Table (12) : Serum levels of thyroxine (T_4)and triiodothyronine (T_3) of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4h/day, 5 days / week) for eight weeks.

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
T4 (n mol/L)	196.70 ± 9.00	229.30^{a*} ± 7.80	235.70^{a**b} ± 9.50	220.80^{abc} ± 8.00	*
T3 (n mol/L)	1.50 ± 0.14	1.35^{a} ± 0.02	1.07$^{a**\,b*}$ ± 0.06	1.20^{a*bc} ± 0.06	**

Values expressed as mean ± standard error

* = Significant difference at P < 0.05
** = Significant difference at P < 0.01
a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III

Table (13) : Serum levels of testosterone of male albino rats exposed to unleaded gasoline vapor (1, 2 and 4 g/m^3 for 4h/day, 5 days / week) for eight weeks.

Group / Exposure Dose / Parameter	Control (0 g/m^3)	Group I (1g/m^3)	Group II (2g/m^3)	Group III (4g/m^3)	"F"
Testosterone (ng/ml)	1.85 ± 0.18	0.94^{a**} ± 0.19	1.11^{a**b} ± 0.14	$0.68^{a***bc*}$ ± 0.15	**

Values expressed as mean ± standard error

* = Significant difference at P < 0.05
** = Significant difference at P < 0.01
*** = Significant difference at P < 0.001

a = Refers to the relation of control group with other groups
b = Refers to the relation of group I with G II and GIII
c = Refers to the relation of G II with G III

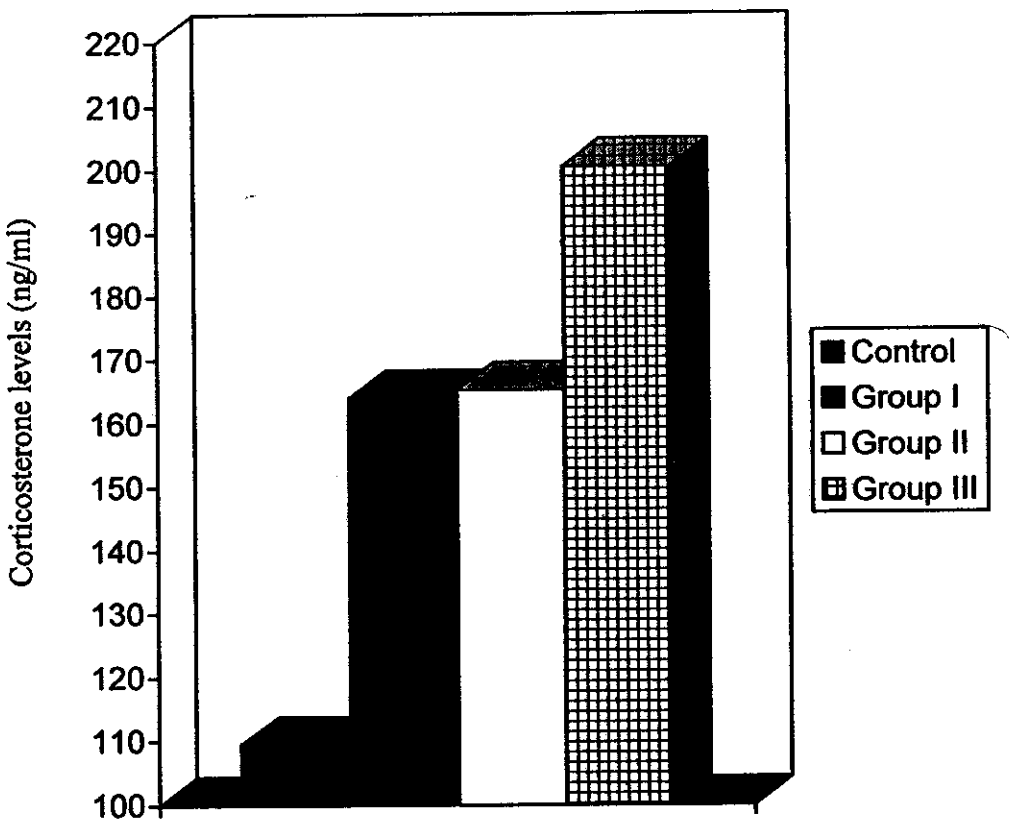
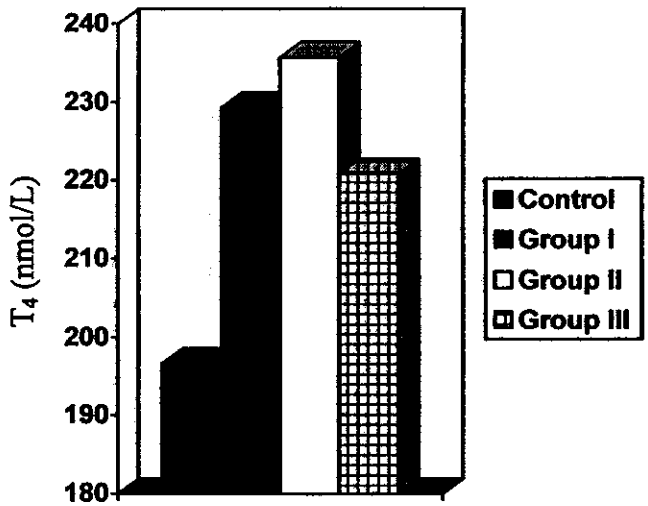


Fig. (18) : Corticosterone levels (ng/ml) in serum of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

(a)



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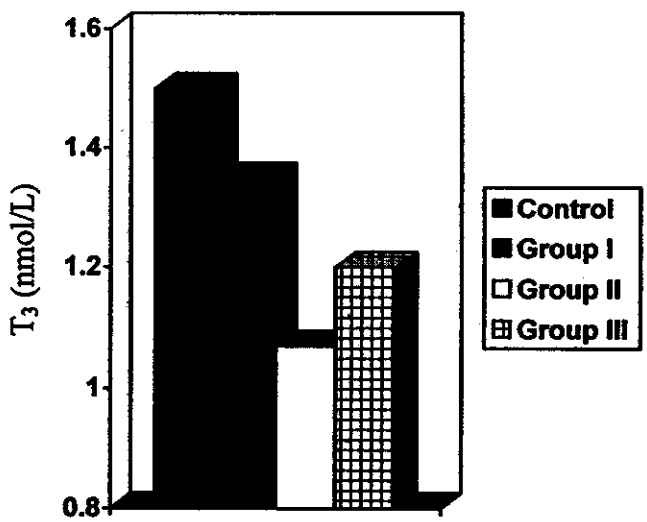


Fig. (19) : The levels of T_4 (a) and T_3 (b) in serum of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

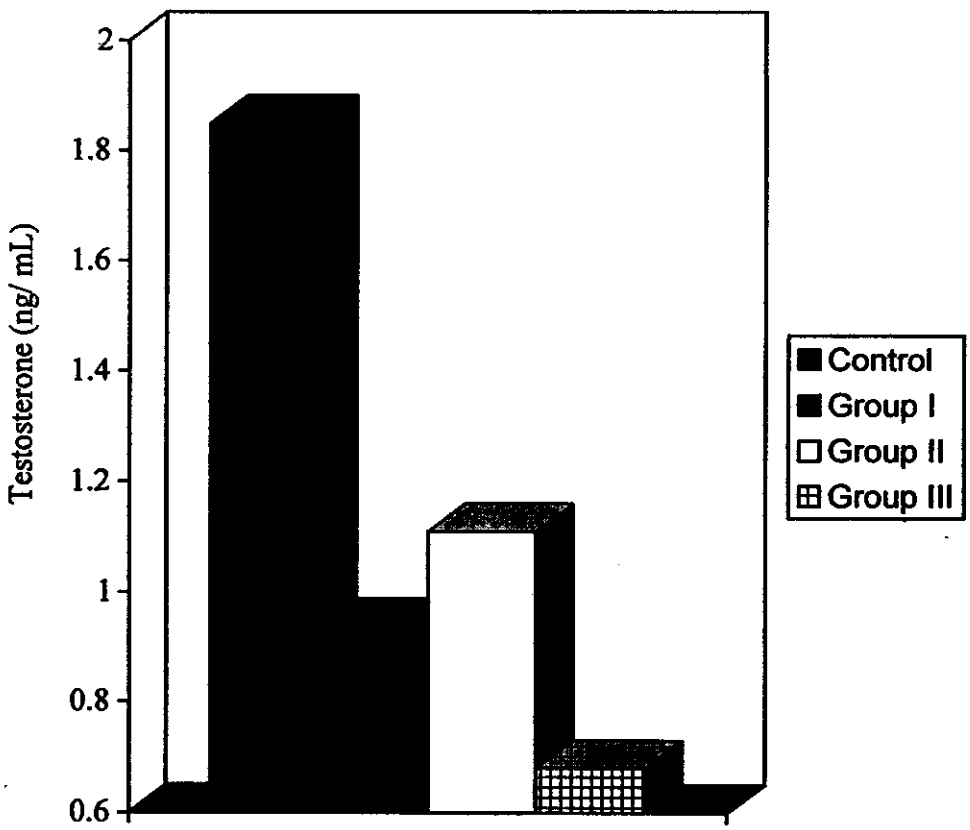


Fig. (20) : The levels of testosterone (ng/ mL) in serum of male albino rats exposed to three levels of unleaded gasoline vapor; 1, 2 and 4 g/m^3 (group I, group II and group III respectively) for 4h/day, 5 days/week for eight weeks.

Histopathological Examination :

The result of the present study showed that gasoline inhalation induced marked histological alterations in lung, trachea, brain and testicular tissues.

These alterations were more apparent in group III (high dose), but were also evident in group II (mid-dose) and were mild in group I (low dose).

Concerning the lung tissue group I (low dose), showed hyperplasia of the peribronchial lymphoreticular tissues and thickening of the blood vessels walls (Fig 21). In some cases there was perivascular eosinophilic infitration (Fig 22). Concerning group II, the lung tissue showed more reaction, in addition to those observed in group I, vasculitis and perivasculitis were clear characterized by eosinophilic and or lymphocytic infiltration in the blood vessel walls and around the vessels themselves (Fig 23). Proliferative hyperplasia was marked in most of the respiratory epithelium including the alveolar wall, peribronchial lymphoreticular tissue (Fig 24). Some animals showed hyaline degeneration of the alveolar epithelium (Fig 25) focal areas of golden-yellow to brown pigment deposition in the interstitial tissue of the lung. Concerning group III The progressive intersitial fibrosis (Fig 26) was noticed in most of examined lung tissues with associating interirregular alveolar collapse. The most conspicous changes were proliferative reaction of the alveolar wall with foreign body giant cell formation (Fig 27) and neoplastic reactions which began from foci of a typical clear cells (Fig 28), adenomatous reaction (Fig 29) and adenocarcinomatous reaction, with varing degrees of mitosis (Fig 30, 31).

Fig (21) : Section of the lung of rat of group I (exposed to 1g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing hyperplasia of the peribronchial lymphoreticular tissue (H & E × 100).

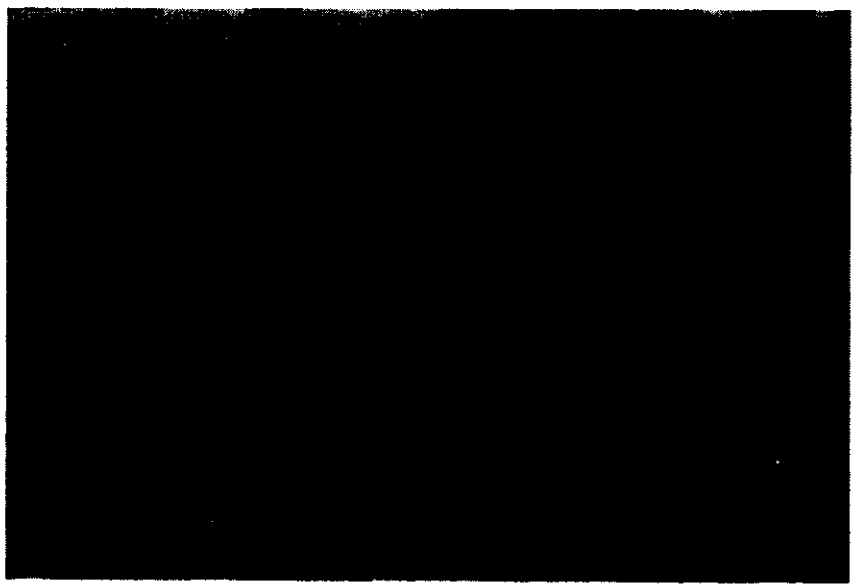


Fig (22) : Section of the lung of rat of group I (exposed to 1g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing perivascular eosinophilic, cells infiltration (H & E × 100).

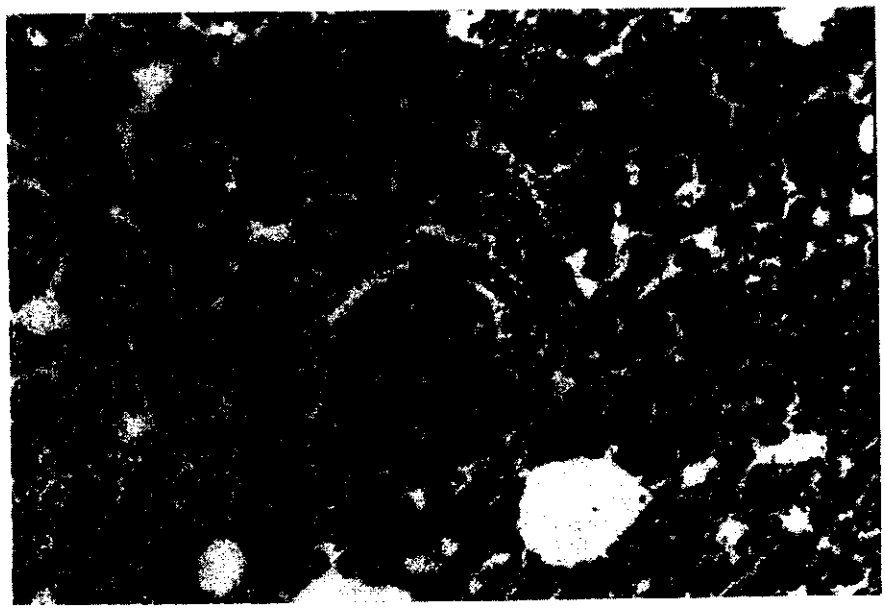


Fig (23) : Section of the lung of rat of group II (exposed to 2g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing vasculitis and perivasculitis. Notic, the lymphocytic and eosinophilic cells infiltration (H & E × 200).

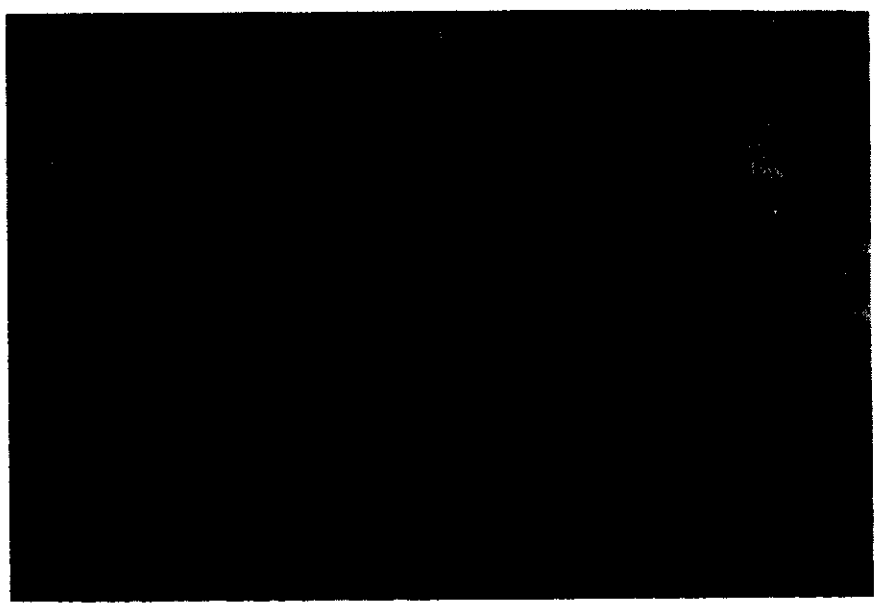


Fig (24) : Section of the lung of rat of group II (exposed to 2g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing marked hyperplasia of lymphoretieular tissue (H & E × 100).

Fig (25) : Section of the lung of rat of group II (exposed to 2g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing hyaline degeneration of the alveolar epithelium and proliferative reaction in other areas (H & E × 200).

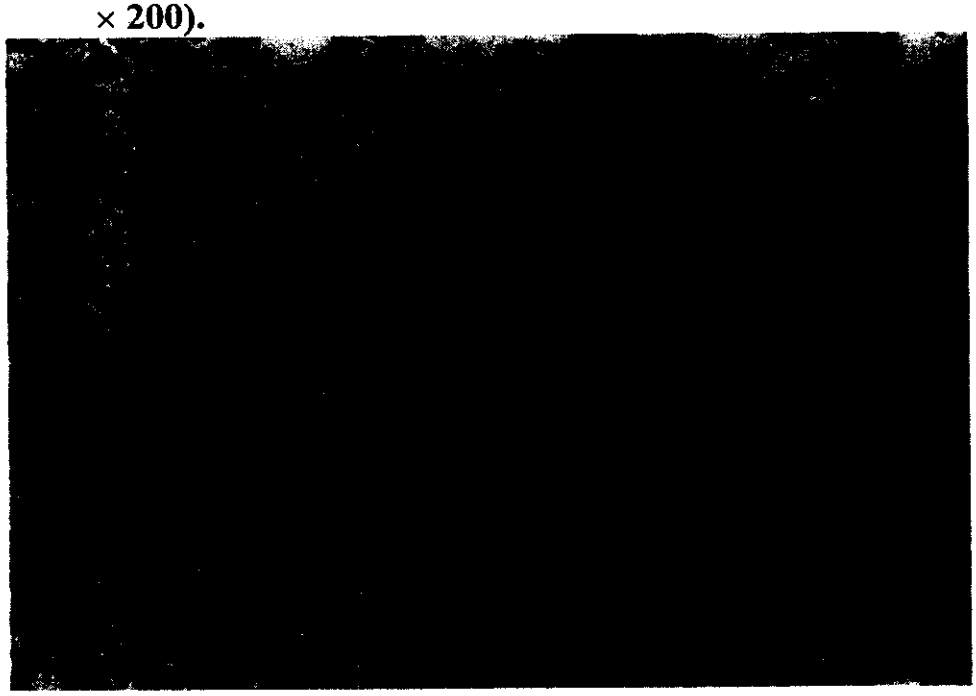


Fig (26) : Section of the lung of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing progressive interstitial fibrosis with the appearance of brown pigment deposition (H & E × 200).

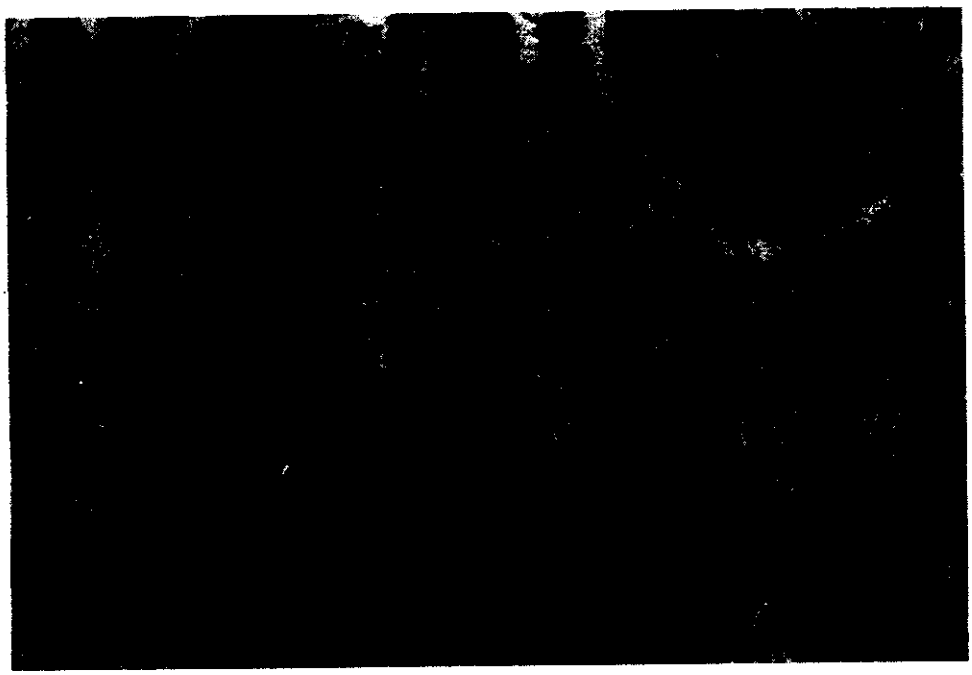


Fig (27): Section of the lung of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing proliferative reaction of alveolar epithelium, thickening of blood vessel wall and appearance of foreign body giant cell (arrow) (H & E × 200)

Fig (28) : Section of the lung of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing group of atypic clear cells (H & E × 400).

Fig (29) : Section of the lung of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing a pattern of adenomatous reaction of the proliferated alveolar epithelium (H & E × 400).

Fig (30): Section of the lung of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing a pattern of adenocarcinomatous reaction of the proliferating alveolar epithelium (H & E × 100).

Fig (31) : Higher magnificantion of Fig. 36 showing mitotic reaction of some cells (arrow) (H & E × 400)

The histopathological changes in trachea under the effect of gasoline inhalation was evident in group I but it was more clear in group II represented by proliferation of the tracheal epithelium, with few mononuclear cell infiltration in the submucosal layer (Fig 32). Concerning group III tracheal tissue showed focal areas squamous metaplasia of the tracheal epithelium at which the normal simple columner epithelium converted to stratified squamous epithelium (Fig 33).

Concerning brain tissue in group I brain lesions with glial reactions, in the form of focal glial nodules in the cerebral cortex (Fig 34) and mild neuronal degeneration (Fig 35). In group II brain alterations characterized by more apparent neuronal degeneration and focal and diffuse gliosis (Fig 36, 37) focal areas of demylination. In 2 animals, the neurons appeared deeply basophilic with out nuclei or with degenerated nuclei (Fig 38). In group III brain sections showed astrogliosis (Fig 39) microgliosis, neuronophagia (Fig 40) and were accompanied with focal neutrophilic dust cells appearance in 3 cases (Fig 41).

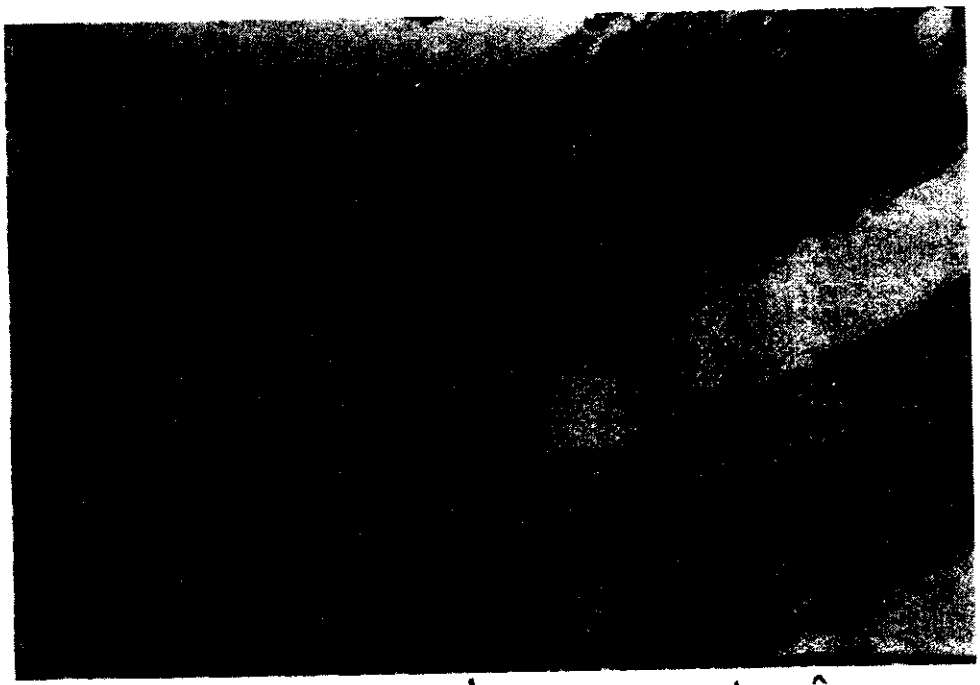


Fig (32) : Section of the tracheal of rat of group II (exposed to 2g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing tracheitis, notice the mononuclear cells infiltration in the subepithelial layer (H & E × 100).

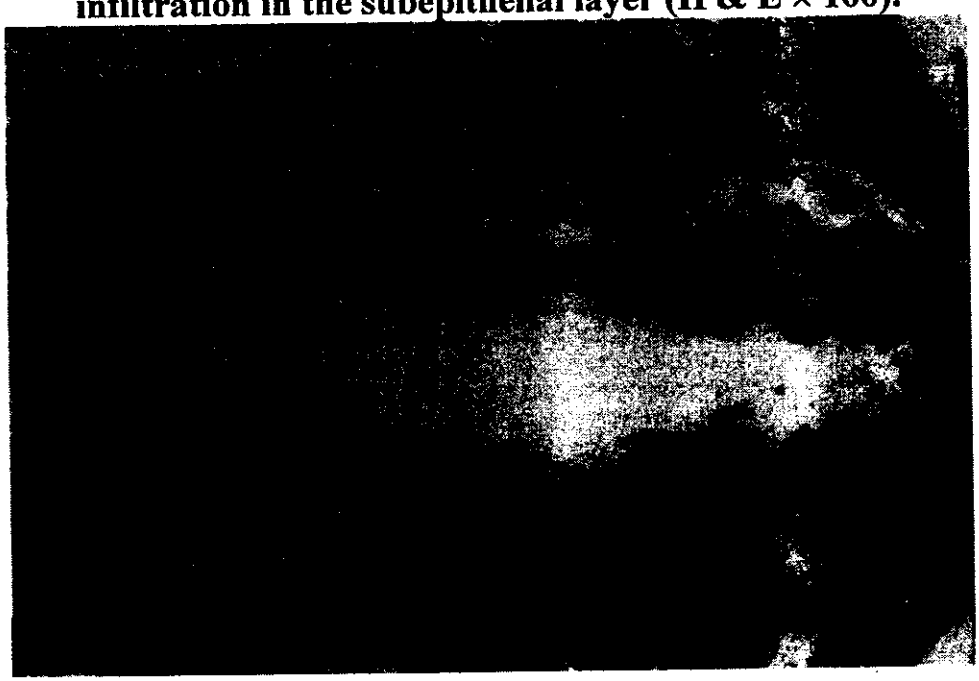


Fig (33) : Section of the tracheal of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing squamous metaplasia of the tracheal epithelium (arrow) (H & E × 200).

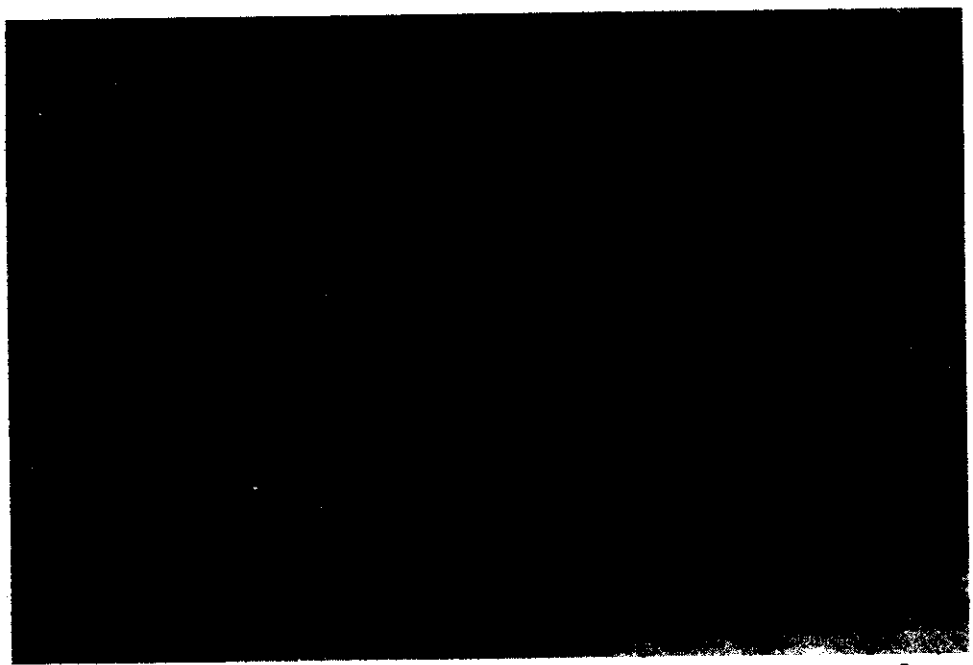


Fig (34) : Section of the brain of rat of group I (exposed to 1g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing focal glial nodules (arrows) in the cerebral cortex (H & E × 100).

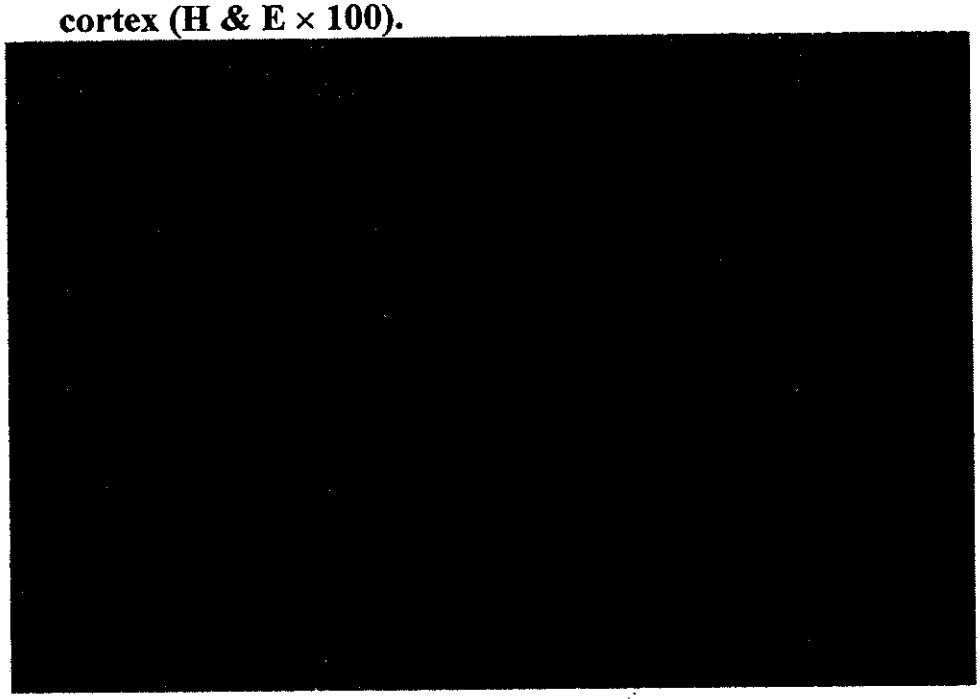


Fig (35) : Section of the brain of rat of group I (exposed to 1g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing mild neuronal degeneration. Notice the eosinophilic appearance of the neurons (arrows) (H & E × 200).

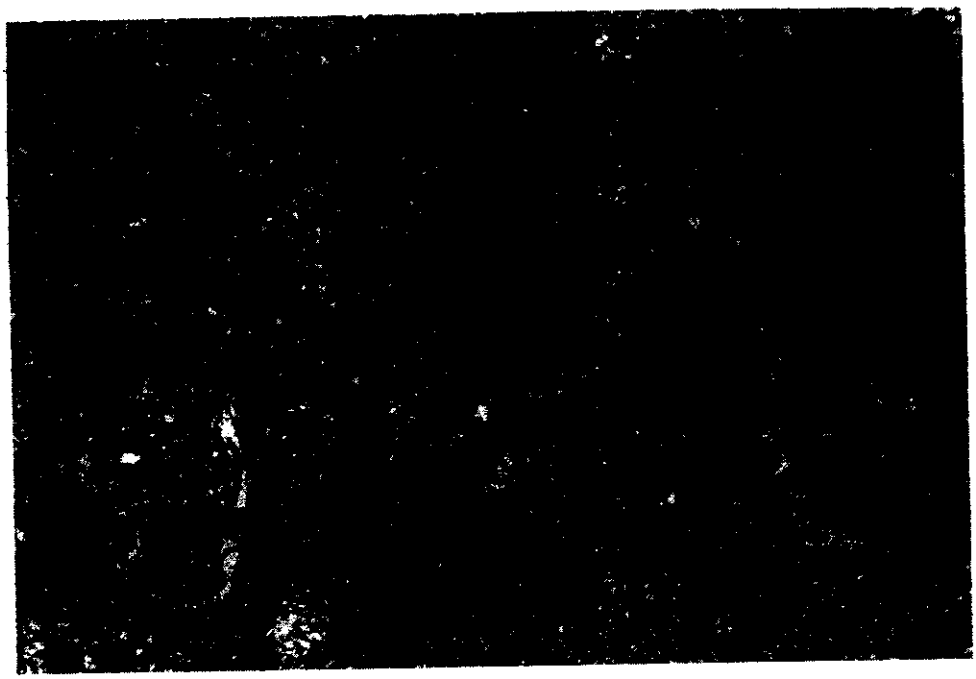


Fig (36) : Section of the brain of rat of group II (exposed to 2g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing large glial nodule (H & E × 100).

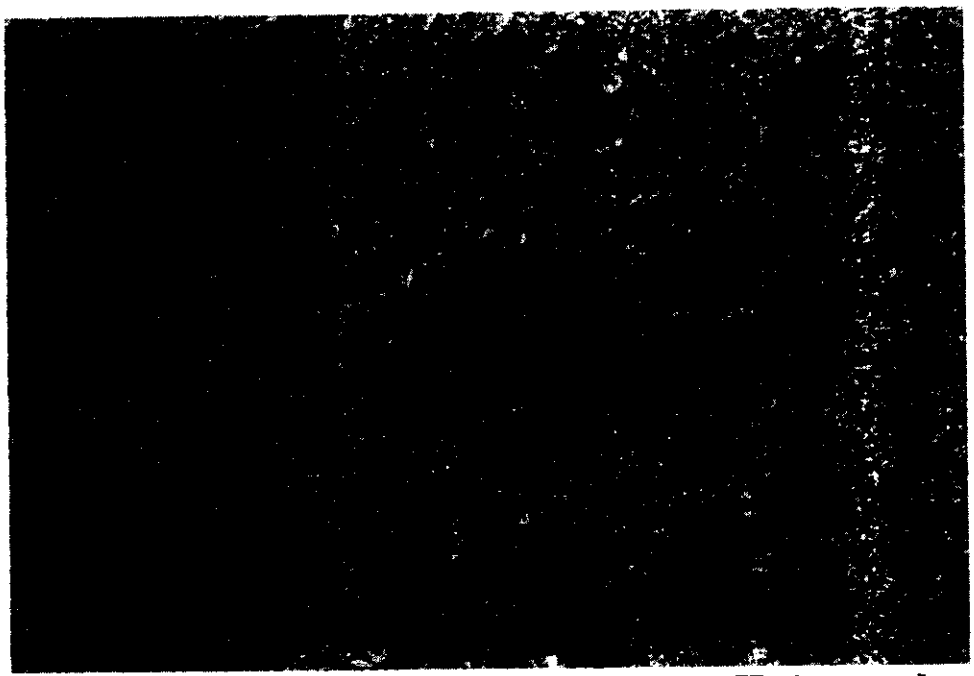


Fig (37) : Section of the brain of rat of group II (exposed to 2g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing neuronal degeneration (arrow head) and microgliosis notice microglia cells (arrow) (H & E × 200).

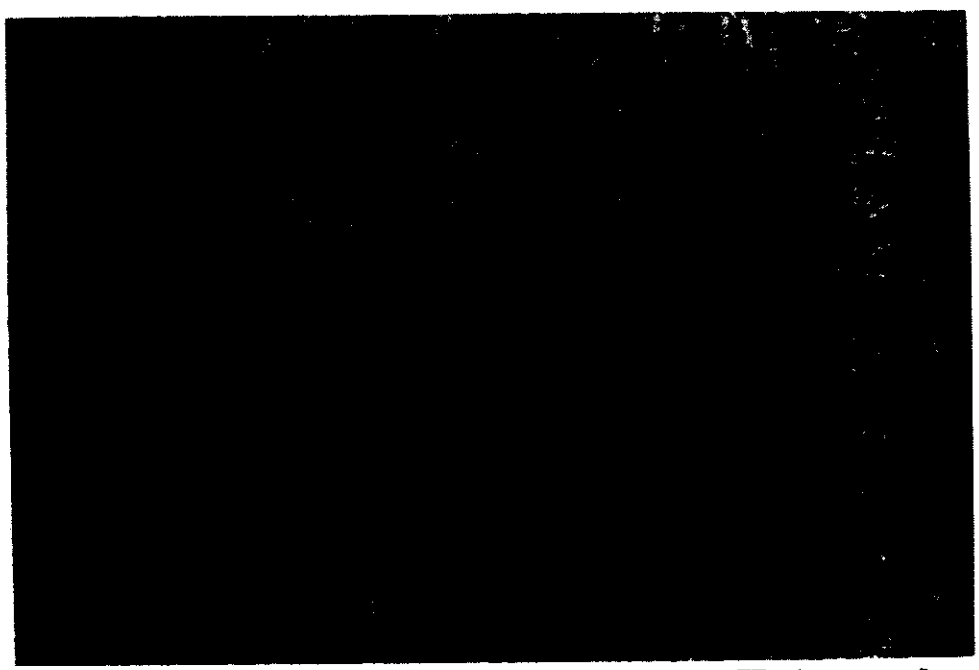


Fig (38) : Section of the brain of rat of group II (exposed to 2g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing basophilic appearance of the degenerated neurons (H & E × 400)

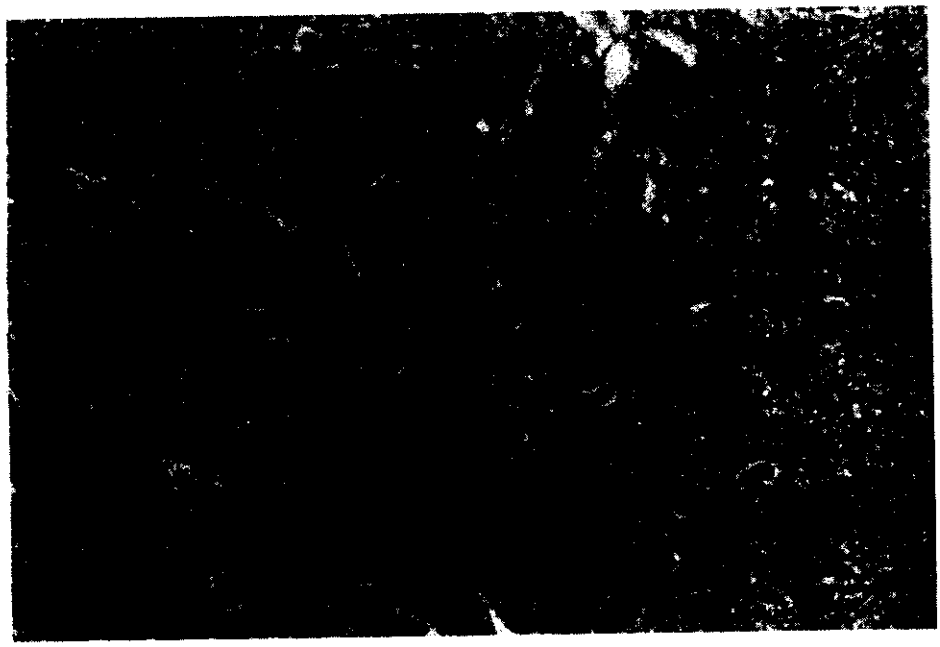


Fig (39) : Section of the brain of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing astrogliosis notice, the arrangement of the astrocytes in a nodular pattern (H & E × 400)

Fig (40): Section of the brain of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing neuronal degeneration, neuronophagia, notice the microgliosis (arrow) (H & E × 200).

Fig (41) : Section of the brain of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing focal neutrophilic dust cells appearance (H & E × 200)

Concerning testicular tissue no testicular lesions could be observed in both group I and II. In group III testicular lesions were more marked in this group as, more necrobiotic changes of the spermatogonial cells with appearance of spermatide-giant cells in the lumen of some seminephrous tubules (Fig 42 & 43). Defective spermatogenesis and spermiation were more pronounced at which most of the seminephrous tubules were deveoid of active sperms present in their lumen with absence of most of the spermatogonial cell layers.

Concerning liver and kidney tissues there were no changes in the structure of both liver and kidney in treated animals.

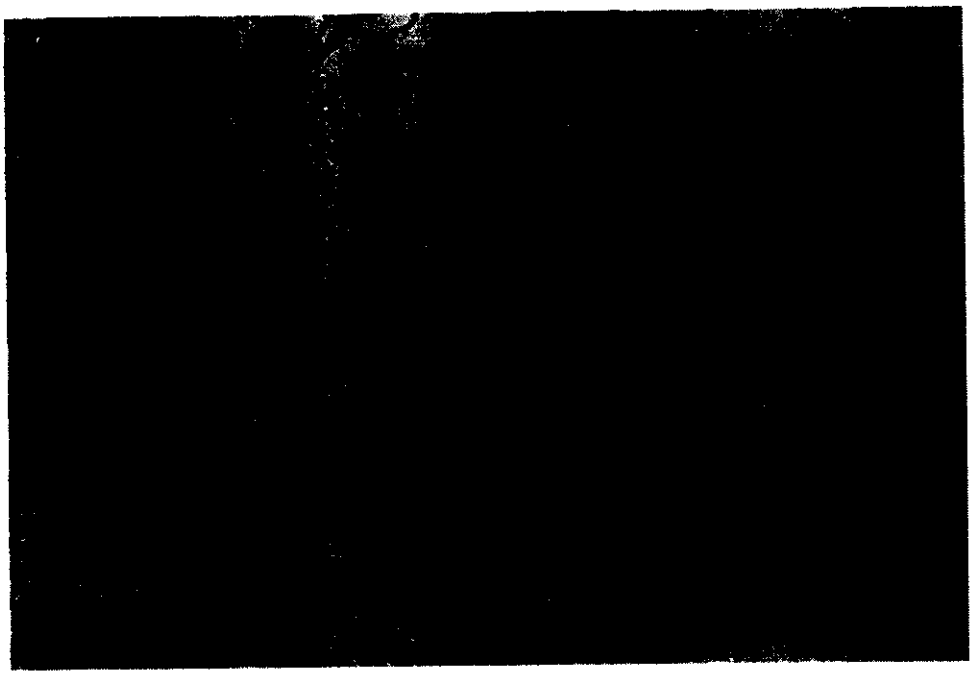


Fig (42) : Section of the testis of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing interstitial oedema (arrow), and degeneration of the spermatogonial cells (H & E × 200).

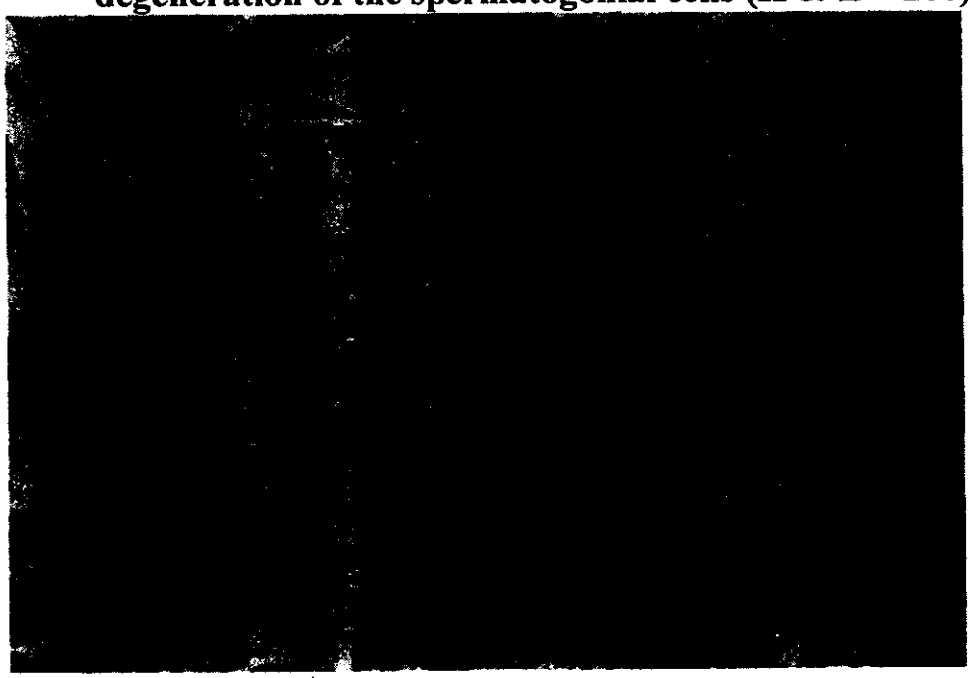
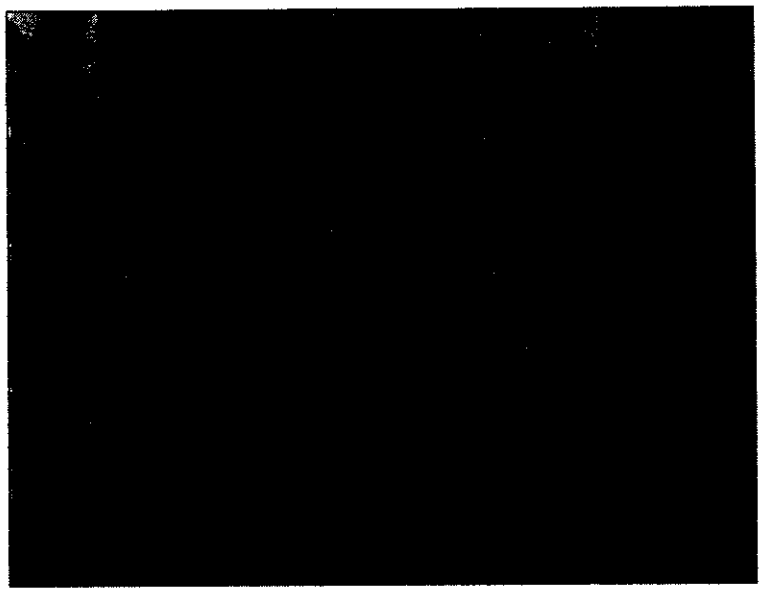


Fig (43) : Section of the testis of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing spermatid gianl cell in the lumen of some seminephrous tubules (arrow) (H & E × 400)

Fig (44): Section of the liver of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing normal structure of the liver (H & E × 200)

a



b

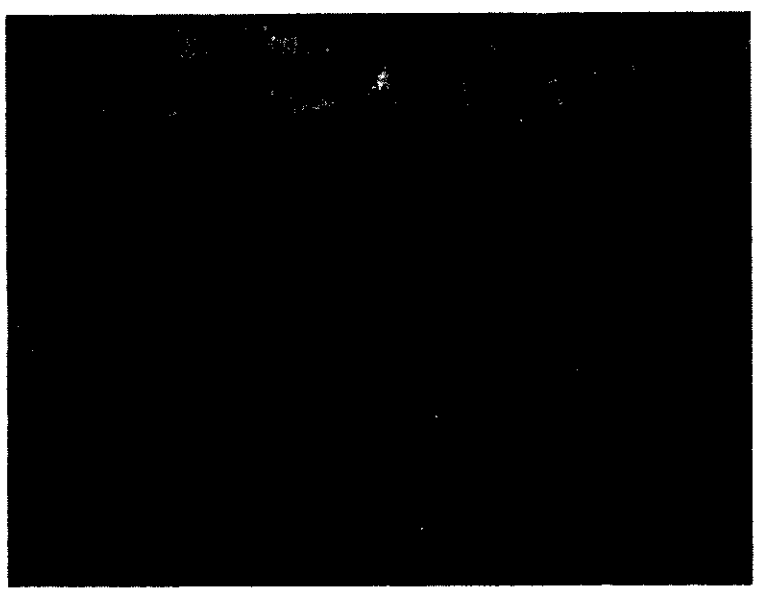


Fig (45) : Section of the kidney of rat of group III (exposed to 4g/m^3 unleaded gasoline vapor for 4h/day, 5 days/week, for eight weeks), showing normal structure of the kidney a = cortex, b = medulla (H & E × 200).