International Journal of Research and Reviews in Pharmacy and Applied science

www.ijrrpas.com

ACUTE EXPOSURE OF ENDOSULFAN ON BEHAVIOUR OF RATS

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ABSTRACT

Hypothalamus may also participate in the control of appetite as the lateral nuclei serve as the feeding centre which when stimulated causes hyperphagia . The destruction of lateral hypothalamus causes lack of appetite and progressive inanition, this is a condition characterized by loss of weight, decreased metabolism and muscle weakness Organochlorine pesticides are environmental contaminants because they break down very slowly. Albino rats of 4, 5 and 6 weeks of age were taken as experimental animal and acute sub lethal dose (0.31ppm/kg^{-1} bw, 0.32ppm/kg^{-1} bw and 0.34ppm/kg^{-1} bw, was injected to albino rats. Body weight, food consumption and water intake of animals were measured during 1 to 45 days. Results indicated that sub lethal dose of endosulfan affect food consumption, body weight and water intake. During 1 to 15 days these parameters were decrease in all the experimental rat and after 24^{th} to 27^{th} days these parameter were recovered but four and five week of rats showed slow recovery in body weight, food consumption and water intake in comparison to 6 six week of rats. Hence in the present study the regular intervals of day 15^{th}, day30^{th} and day45^{th} were selected to carryout studies relating to detoxification mechanism.

KEYWORD: hyperphagia, inanition, sub lethal, pesticides, organochlorine

INTRODUCTION

Endosulfan is a non-systemic insecticide and acaricide with contact and stomach poison. It has been in world-wide uses since its introduction in the 1950′s. Endosulfan is successfully used for controlling numerous insect pests and some mites in a wide variety of different crops. It acts via the GABA receptor system (opening the chloride transport, increasing glutamate level) (USEPA-2010). Organochlorine pesticides are environmental contaminants because they break down very slowly. According to the Centers for Disease Control and Prevention (CDC) and most people have organochlorine pesticides present in their bodies (ATSDR/CDC. 1990). Exposure of endosulfan is high. Apart from occupational exposure which has resulted in many poisonings residues in food and drinking water are widespread globally at sufficiently high levels to constitute a threat to human health. Repeated exposure to a tolerated dose of endosulfan resulted in a deficit of behavioral responses involving both learning and memory. A serotonergic (activated by or capable of liberating serotonin, especially in transmitting nerve impulses) mechanism appeared to be involved significantly in endosulfan-induced learning impairment and negligibly in its memory disrupting action. (Paul, Balasubramaniam and. Kazi1994).

MATERIAL AND METHOD

Insecticide: The liquid endosulfan (Thioden 35% EC) used in this study was obtained from Northern Minerals Limited agrochemical shop in watt market, Ahmedabad, (Guj.) Technically endosulfan is a mixture of two isomers-alpha-endosulfan and beta-endosulfan in the ratio 7:3.

Experimental design: Thirty albino rats of 4, 5 and 6 weeks of age were taken as experimental animal and divided into six groups of five rats in each group (n = 5). The first three groups' I, II, III were served as control and other three groups IV, V, VI were served as experimental. Groups IV, V, VI were injected sub lethal dose of endosulfan (0.31ppm/kg-1 bw) (0.32ppm/kg-1 bw) (0.34ppm/kg-1) in 4 week 5 week and 6 week of rats respectively. Body weight, Food consumption and water intake of these groups were measured during 1 to 45 days after administration of a sublethal dose of endosulfan. All parameters were recorded after every 72hrs in both groups.

OBSERVATIONS

Acute sub lethal dose was estimated by graphical probit method of Miller and Tainer (1944) and observation Tables for behavioural parameters such as body weight, food consumption and water intake are given below.

Comparisons between treated and control rats

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	33.0	33.2	33.5	34.9	34.4	**34.7**	35.1	35.6	35.9	36.4	**36.8**	37.3	37.7	38.2	38.9	**39.8**
± SD	2.3	2.7	2.6	3.0	3.2	**3.1**	2.4	2.2	2.3	2.2	**2.1**	2.3	2.4	1.8	0.6	**0.5**
Percent%		0.6	0.89	1.14	1.45	**0.86**	1.13	1.40	1.11	1.37	**1.08**	1.34	1.06	1.30	1.79	**2.26**
Exposed	33.0	32.6	32.1	31.7	31.2	**30.8**	30.3	29.7	28.8	29.0	**29.3**	29.6	29.9	30.3	30.7	**31.3**
± SD	2.1	2.4	3.1	2.5	2.3	**3.8**	3.0	4.1	4.2	3.9	**3.2**	4.8	4.7	5.1	5.5	**5.3**
Percent%		-1.8	-1.5	-1.2	-1.6	**-1.2**	-1.6	-2.0	-1.7	1.3	**1.7**	1.0	1.0	1.3	1.3	**1.9**

Table: 1.1 Change in mean body weight of four week of albino rats during the exposure:
Values are Mean±SE; Comparisons between treated and control rats

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	38.3	38.7	39.2	39.7	40.4	**40.9**	41.5	42.1	42.7	43.2	**43.8**	44.4	44.9	45.3	46.5	**47.6**
± SD	1.2	2.4	1.9	1.6	1.8	**1.2**	1.0	0.7	0.9	0.5	**1.1**	1.6	2.7	1.09	1.2	**1.6**
Percent%		1.03	1.27	1.25	1.73	**1.22**	1.44	1.42	1.40	1.15	**1.36**	1.35	1.11	0.8	2.58	**2.31**
Exposed	38.5	38.2	37.6	36.9	35.7	**35.1**	34.8	34.2	33.7	33.9	**34.4**	34.9	35.3	35.7	36.5	**37.2**
± SD	1.0	1.6	1.2	1.5	1.2	**1.4**	0.7	0.9	0.4	1.0	**1.4**	1.0	1.2	1.09	2.09	**2.03**
Percent%		-0.79	-1.59	-1.89	-3.36	**-1.70**	-0.8	-1.17	-1.48	0.5	**1.45**	1.43	1.13	1.12	2.19	**1.88**

Table: 1.2 Change in mean body weight of five week of albino rats during the exposure

Values are Mean±SE; Comparisons between treated and control rats

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	42.4	42.9	43.5	44.2	44.7	**45.3**	45.8	46.3	46.9	47.3	**47.9**	48.4	48.8	49.2	49.9	**50.5**
± SD	2.7	2.6	3.2	3.1	3.2	**3.0**	2.4	2.2	2.3	2.2	**2.4**	2.4	1.7	1.0	0.8	**0.7**
Percent%		1.16	1.36	1.58	1.11	**1.32**	1.09	1.07	1.27	0.84	**1.25**	1.03	0.81	0.81	1.40	**1.18**
Exposed	42.6	42.2	41.8	41.3	40.9	**40.6**	40.2	39.5	38.8	39.3	**39.8**	40.2	40.6	40.9	41.4	**41.9**
± SD	1.4	2.5	3.1	3.5	3.8	**4.3**	3.9	4.3	3.9	4.7	**4.7**	5.1	5.1	5.2	4.9	**5.3**
Percent%		-0.9	-1.43	-1.21	-0.97	**-0.73**	-0.99	-1.77	-1.80	1.27	**1.25**	0.99	0.98	0.73	1.20	**1.19**

Values are Mean±SE; Comparisons between treated and control rats

Table :1.3 Change in mean body weight of six week of albino rats during the exposure

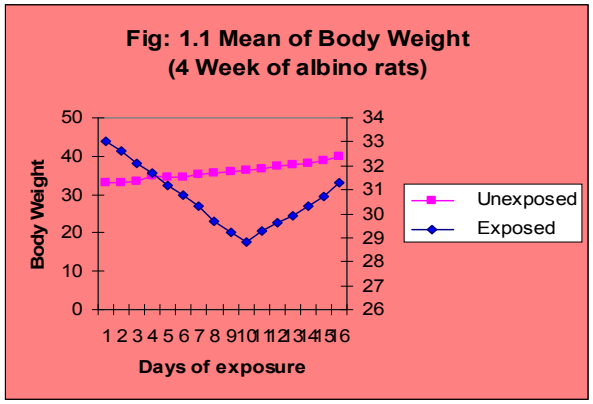


Fig: 1.1 Mean of Body Weight
(4 Week of albino rats)
Body Weight
Days of exposure
Unexposed
Exposed

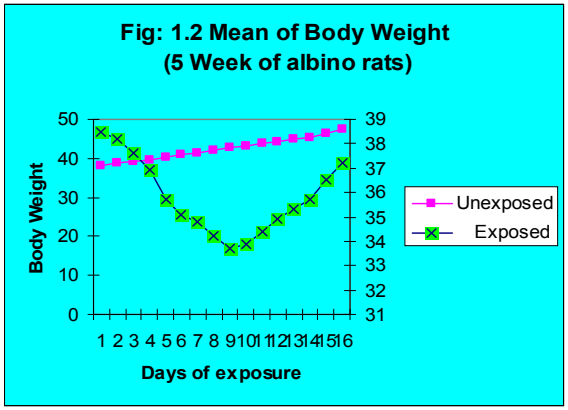


Fig: 1.2 Mean of Body Weight
(5 Week of albino rats)
Body Weight
Days of exposure
Unexposed
Exposed

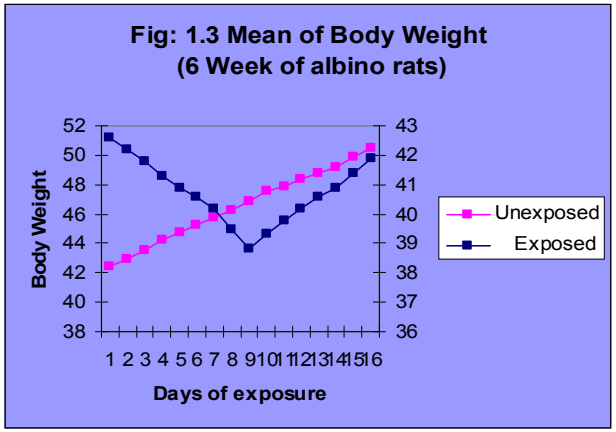


Fig: 1.3 Mean of Body Weight
(6 Week of albino rats)
Body Weight
Days of exposure
Unexposed
Exposed

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	9.68	9.73	9.79	9.86	9.94	**9.99**	10.07	10.15	10.21	10.29	**10.37**	10.44	10.53	10.64	10.71	**10.87**
± SD	1.05	0.22	0.48	0.63	0.30	**0.34**	0.52	0.43	0.16	0.67	**0.39**	0.32	0.76	0.27	0.90	**0.69**
Percent%		1.0	0.6	0.7	0.8	**0.5**	0.7	0.7	0.5	0.7	**0.7**	0.6	0.8	1.0	0.6	**1.4**
Exposed	9.74	8.22	7.48	6.55	6.48	**6.40**	6.33	6.21	6.16	6.23	**6.38**	6.51	6.78	7.16	7.69	**8.27**
± SD	0.14	0.32	0.28	0.56	0.60	**0.34**	0.64	0.72	0.45	0.32	**0.24**	0.82	0.76	0.32	0.43	**0.89**
Percent%		-18	-9.8	-1.4	-1.0	**-1.2**	-1.1	-1.9	-0.8	1.1	**2.3**	1.9	3.9	5.6	6.8	**7.0**

Values are Mean±SE; Comparisons between treated and control rats

Table: 2.1 Change in mean food consumption in four week of albino rats during the exposure

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	10.46	10.57	10.51	10.59	10.70	**10.81**	10.90	10.97	11.04	11.16	**11.29**	11.40	11.52	11.61	11.77	**11.91**
± SD	.04	0.73	0.34	0.57	0.68	**0.46**	0.23	0.76	0.29	0.89	**0.45**	0.67	0.83	0.60	0.52	**0.34**
Percent%		0.6	0.5	0.7	1.0	**1.0**	0.9	0.6	0.6	1.08	**1.15**	0.9	1.04	1.12	1.0	**1.18**
Exposed	10.49	9.78	9.66	9.43	9.35	**9.23**	9.06	8.93	9.04	9.19	**9.35**	9.48	9.61	9.88	10.03	**10.20**
± SD	0.23	0.34	0.67	0.78	0.32	**0.67**	0.56	0.39	0.39	0.72	**0.33**	0.48	0.36	0.66	0.14	**0.48**
Percent%		-2.0	-2.1	-1.3	-0.8	**-1.2**	1.7	-1.3	1.2	1.5	**1.6**	1.3	2.0	1.8	1.4	**1.5**

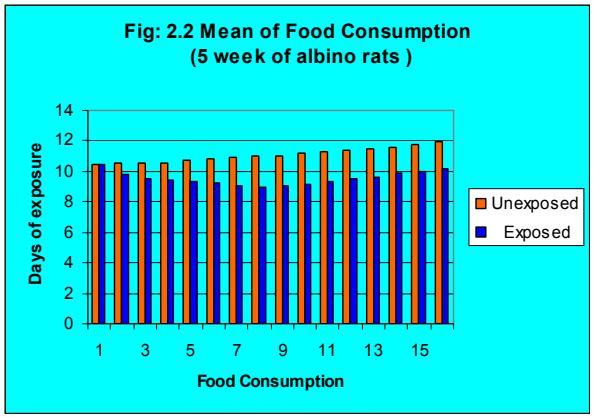
Values are Mean±SE; Comparisons between treated and control rats

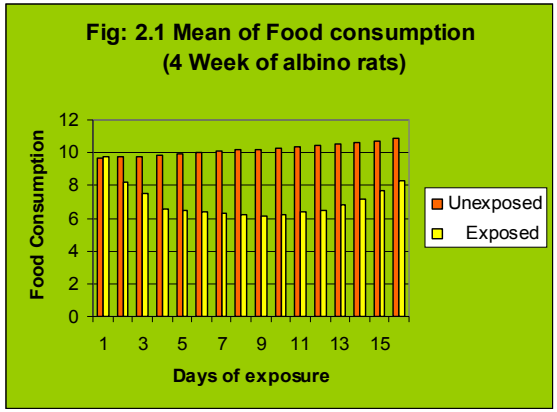
Table: 2.2 Change in mean food consumption in five week of albino rats during the exposure

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	12.52	12.64	12.72	12.85	12.97	**13.14**	13.25	13.36	13.48	13.62	**13.73**	13.89	13.96	14.23	14.43	**14.67**
± SD	0.78	0.68	0.72	0.65	0.48	**0.65**	0.60	0.27	0.34	0.31	**0.45**	0.86	0.79	0.65	0.53	**0.53**
Percent%		0.9	0.8	1.01	0.9	**1.2**	0.8	0.8	0.9	1.02	**0.9**	1.15	0.5	1.8	1.3	**1.6**
Exposed	12.78	12.63	12.48	11.26	11.03	**10.92**	10.82	10.64	10.76	10.85	**10.97**	11.14	11.22	11.35	11.52	**11.73**
± SD	0.27	0.38	0.51	0.24	0.21	**0.30**	0.24	0.23	0.21	0.32	**0.22**	0.19	0.21	0.20	0.29	**0.21**
Percent%		-1.18	-1.20	-0.9	-1.9	**-1.07**	-0.9	-1.69	1.1	0.8	**1.09**	1.52	0.7	1.14	1.48	**1.79**

Values are Mean±SE; Comparisons between treated and control rats

Table: 2.3 Change in mean food consumption in six week of albino rats during the exposure





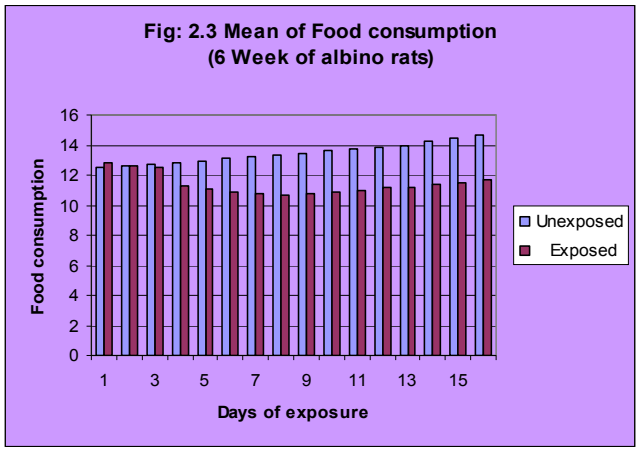


Table: 3.1 Change in mean water intake in four week of albino rats during the exposure

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	14.78	14.55	14.68	14.72	14.89	**14.97**	14.89	15.17	15.28	15.37	**15.23**	15.38	15.43	15.62	15.87	**15.93**
± SD	0.45	0.34	1.26	0.97	0.67	**0.78**	0.21	1.09	0.54	0.22	**0.89**	0.99	1.42	0.83	0.12	**0.76**
Percent%		-1.58	0.08	0.21	1.14	**0.53**	-0.53	1.84	0.71	.058	**-0.91**	0.97	0.32	1.21	1.57	**0.37**
Exposed	14.95	14.48	14.38	14.12	13.93	**13.78**	13.62	13.55	13.73	13.91	**14.09**	14.23	14.41	14.54	14.67	**14.79**
± SD	0.33	0.67	0.75	0.88	0.32	**0.25**	1.03	0.38	0.92	0.72	**0.76**	0.89	0.34	1.07	1.19	**0.67**
Percent%		-3.24	-0.69	-1.84	-1.36	**-1.08**	-1.15	-0.51	1.31	1.29	**1.27**	0.98	1.24	0.89	0. 88	**0.81**

Values are Mean±SE; Comparisons between treated and control rats

Table: 3.1 Change in mean water intake in four week of albino rats during the exposure

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	21.16	21.58	20.49	21.78	20.92	**21.83**	20.93	21.63	21.91	22.47	**22.86**	22.67	22.23	22.52	22.63	**22.81**
± SD	1.02	0.74	1.16	0.86	0.87	**0.90**	0.72	2.09	0.54	0.95	**2.50**	1.11	1.06	2.07	1.83	**1.72**
Percent%		1.94	-5.31	5.92	-4.11	**4.16**	-4.30	3.23	1.27	2.49	**1.73**	-0.8	-1.97	1.28	0.48	**0.81**
Exposed	20.35	19.21	18.08	17.68	17.44	**17.28**	16.80	16.63	16.32	16.40	**16.59**	16.72	16.87	17.36	18.23	**18.62**
± SD	0.36	0.08	0.72	0.51	0.76	**0.93**	1.09	1.63	1.27	1.27	**1.52**	1.63	1.27	1.54	0.43	**1.14**
Percent%		-5.93	-6.25	-2.26	-1.37	**-0.92**	-2.82	-2.68	-1.48	2.41	**1.37**	1.54	3.91	2.82	4.77	**2.09**

Values are Mean±SE; Comparisons between treated and control rats

Table: 3.2 Change in mean water intake in five week of albino rats during the exposure

Days of treatment	0	3rd	6th	9th	12th	**15th**	18th	21st	24th	**27th**	**30th**	33rd	36th	39th	42nd	**45th**
Unexposed	23.26	24.65	22.47	20.29	21.00	**22.70**	22.49	22.44	21.88	20.24	**21.68**	23.18	24.28	23.78	24.48	**23.64**
± SD	1.62	2.44	1.56	1.96	1.67	**1.98**	1.12	1.02	0.71	0.90	**0.45**	1.01	1.46	2.17	1.37	**1.36**
Percent%		5.6	-9.7	-10.7	3.3	**7.48**	-0.93	0.22	-2.5	-8.10	**6.64**	6.47	4.5	-2.10	2.85	**-3.55**
Exposed	24.56	22.36	21.43	20.08	18.64	**18.37**	17.92	17.41	16.86	16.99	**17.28**	17.41	17.63	17.89	17.74	**17.93**
± SD	0.76	0.38	0.62	0.61	0.79	**0.99**	1.07	1.43	1.59	1.65	**1.63**	1.83	1.05	1.34	1.05	**1.34**
Percent%		-9.83	-4.3	-6.72	-2.24	**-1.14**	-2.51	-2.92	0.71	0.76	**1.68**	0.74	1.24	1.45	1.24	**1.45**

Values are Mean±SE; Comparisons between treated and control rats

Table: 3.3 Change in mean water intake in six week of albino rats during the exposu

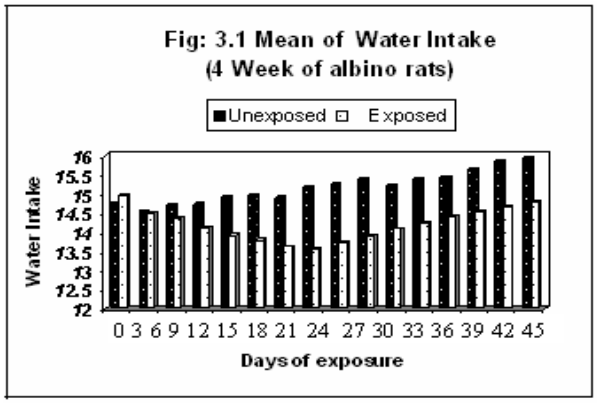


Fig: 3.1 Mean of Water Intake
(4 Week of albino rats)
Unexposed
Exposed
Water Intake
16
15.5
15
14.5
14
13.5
13
12.5
12
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45
Days of exposure

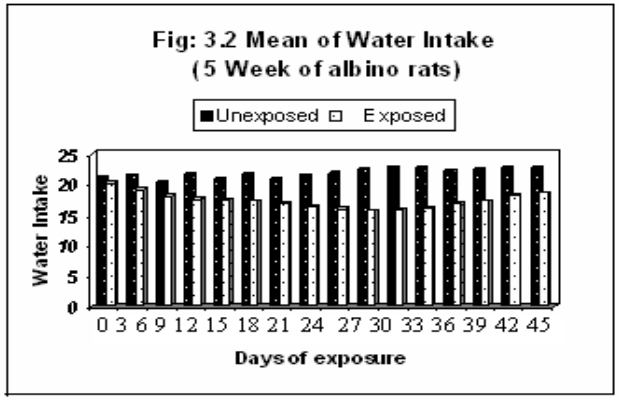


Fig: 3.2 Mean of Water Intake
(5 Week of albino rats)
Unexposed
Exposed
Water Intake
25
20
15
10
5
0
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45
Days of exposure

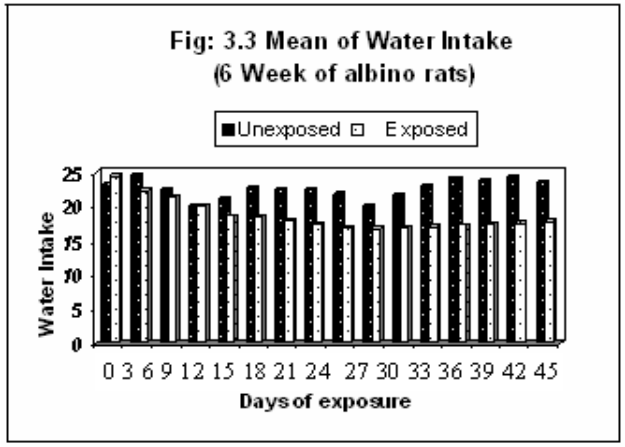


Fig: 3.3 Mean of Water Intake
(6 Week of albino rats)
Unexposed
Exposed
Water Intake
25
20
15
10
5
0
0 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45
Days of exposure

RESULTS

Body Weight:

Body weight of control and experimental albino rats were recorded for 15, 30 and 45 days of exposure. The changes in body weight of animals are presented diagrammatically in Fig: (1.1, 1.2, and 1.3). Data relating to the present changes in body weight of control and experimental rats for days 15, 30 and 45 days are presented in Table (1.1, 1.2, and 1.3). The results indicated that the amount of body weight were increased in control rats such as, +0.86%, +1.22 and +1.32 % on 15th day and +1.08%, 1.36% and +1.25% on 30th day and increase in body weight such as +2.26%, + 2.31% and + 1.18% on 45th day for 4, 5 and 6 week of albino rats respectively, but experimental rats showed decrease in body weight such as, -1.20%, -1.70% and -0.73 at 15th day of exposure. After 27 days the body weight started recovering in experimental group such as, +1.3%, +0.5% and +1.27%. The body weights were recovered at 30th day such as, +1.70%, +1.45% and +1.25% at and +1.9%, +1.88% and +1.19% on 45th day.

Food Consumption

Results pertaining to amount of food consumed are presented in Fig (2.1, 2.2, and 2.3). Values of percentage change in food consumption on days 15, 30 and 45 are presented in Table (2.1, 2.2, and 2.3). The total quantity of food consumption has been consistently greater in control rats as compared to experimental rats. Despite fluctuation observed in food consumption in control and experimental rats showed discernible trend. Table (2.1, 2.2, and 2.3) shows that there was a greater drop in food consumption in experimental rats with time -1.2%, -1.2% and -1.07% on 15th day, while control rats showed normal increments such as +0.5%, +1.0% and +1.2% on 15th day. Between 27th -30th days recovery was started. Exposed rats tended to be a recovered in food consumption the value stood at +2.3% +1.6% and +1.09% on 30th day and +7.0%, +1.5% and +1.79% on 45th day for 4,5 and 6 week of rats respectively.

Water Intake

Data pertaining to water intake of control and experimental rats are presented in Table (3.1, 3.2 and 3.3) and Fig (3.1, 3.2 and 3.3). The control rats consumed more water than the endosulfan treated rats thought out the experimental period. Tremendous fluctuations was noticed on 1 to 45 days, there appears to be a decline in water intake -1.08%, -0.92% and -1.14% on 15th day Table (3.1, 3.2 and 3.3) and after 27 days experimental rats exhibited a remarkable on words recovery as a result the water intake level has been found to be +1.27%, +1.37% and +1.68% on 30th day and +0.81%, +2.09% and +1.45% on 45th day for 4, 5 and 6 week of experimental rats respectively.

DISCUSSION

The result of present work shows that the LD50 value varies significantly according to the purity of the chemical (Khan and Kumari 2011), variable age (Kiran and Verma1988) weight and temperature (Abel, 1980) sex differences (Overstreet et al. 1979), and may also vary due to different suppliers of animals (Russell and Overstreet, 1987).

Behavioural studies such as signs and symptoms, body weight, food consumption, water intake and body temperature are important to know the physiological status of the animal during toxic stress (Overstreet et al. 1979:). As far as the whole body weight changes are concerned. It is evident that the rats did not show any addition to body weight after endosulfan treatment (Table: 1.1,1.2 and 1.3) while the control animals registered a +2.26%, +2.31% and +1.19% rise in body weight on 45 days in 4, 5 and 6 week of rats respectively. Different investigations were also reported weight loss during pesticide treatment. Cooper (1962) reported body weight loss in guinea pigs for 3 weeks when treated with Delnai. Similar decrease in body weight was also reported by Glow et al. (1966) during long term treatment with DFP. Hypothalamus may also participate in the control of appetite as the lateral nuclei serve as the feeding centre which when stimulated causes hyperphagia (Guyton and Hall, 2006). The destruction of lateral hypothalamus causes lack of appetite and progressive inanition, this is a condition characterized by loss of weight, decreased metabolism and muscle weakness (Guyton and Hall, 2006). Swamy and Murali Mohan (1991) observed that weight losses in rats treated with organophosphates compounds is dose dependent.

CONCLUSION

From this study it is clear that animals were adapted to the behavioural changes. It is also evident that the over all symptoms were highest from 27th to 30th days During 1 to 15 days these parameters decreased in all the experimental rat and after 27th to 30 days these parameter were recovered but four and five week of rats showed slow recovery in body weight, food consumption and water intake in comparison of 6 six week of rats because of low immunity in younger stage. From 15th day in 4, 5 and 6 week of rats showed onwards recovery more or less to normal condition on 30 to 45 days. Hence in the present study the regular intervals of 15 days, 30 days and 45 days were selected to carryout studies relating to detoxification mechanism.

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