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INFLAMMATORY RESPONSE IN RAT LUNG AFTER EXPOSURE TO SULPHUR DIOXIDE GAS

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ABSTRACT

In the present study, albino rats, *Rattus norvegicus* (Berkenhout) were exposed to 40 ppm and 80 ppm sulphur dioxide gas for 30 days and 60 days for one hour per day, and inflammatory responses were studied in the lung by physical and biochemical parameters. Significant increases in lung weight, lung total protein and alkaline phosphatase have been observed.

KEY WORDS: Sulphur dioxide, Albino rat, Lung, Protein, Alkaline phosphatase.

INTRODUCTION

Air pollution is a mixture of hazardous substances from both natural and human-made sources. Sulphur dioxide is a common air pollutant. The majority of sulphur dioxide present in the environment is due to the burning of coal and oil at large industrial plants such as oil refineries and power stations. It is produced naturally by active volcanoes and forest fires. Sulfur dioxide (SO_2) is a colorless, reactive gas with an irritating pungent odour. The lungs are a pair of spongy organs within the thoracic cavity that facilitate gaseous exchange from the environment into the blood stream. The inhalation of sulphur dioxide shows an adverse effect on lung tissue.

The present work was conducted to investigate the effects of sulphur dioxide gas exposure on inflammatory response in lung of albino rat.

MATERIALS AND METHODS

The albino rat, *Rattus norvegicus* of both the sexes has been selected for the present investigation. The colony of the albino rats inbred at the animal house of Zoology Department. Thirty healthy and adult rats ranging in weight from 100-120 gm with an average of 114.8±2.0 gm and body size ranging 15-16 cm with an average of 15.5±0.24 cm were kept in polypropylene cages at temperature 25ºC±0.5 ºC, relative humidity 60 ± 5% and photoperiod of 12hrs/day. Food and water was provided *ad libitum*. The sulphur dioxide gas was prepared by method of Singh and Rao (1979). For the generation and exposure of sulphur dioxide gas, sulphur dioxide gas generator and fumigation chamber (Model-AP 07 SEF-120) were used respectively.

The experimental rats were grouped in three sets. One control set 'A' and two experimental sets 'B' and 'C' of twenty rats each. Control set 'A' was exposed to ambient air, while experimental sets 'B' and 'C' were exposed to 40 ppm and 80ppm sulphur dioxide gas for one hour for 30 and 60 days in fumigation chamber. Ten rats were taken out after 30 and 60 days from control and experimental sets and rats were anaesthetized by chloroform. They were dissected carefully and lung was taken out.

The protein content in the lung tissue was estimated by method of Lowery *et al.* (1951) and calculated with the help of standard curve, while alkaline phosphatase was estimated by PNPP kinetic method. Statistical significance between experimental and control values were calculated according to Fischer's students 't' test (Fischer, 1950).

RESULTS AND DISCUSSION

The mean value of lung weight, total protein and

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alkaline phosphatase of control and sulphur dioxide exposed rats are shows in Table 1 and Fig. 1, 2, & 3. In the present study, a significant increase in lung weight correlated with the pulmonary inflammation caused by inhalation of toxic gas which results protein rich edema within the alveolar spaces.

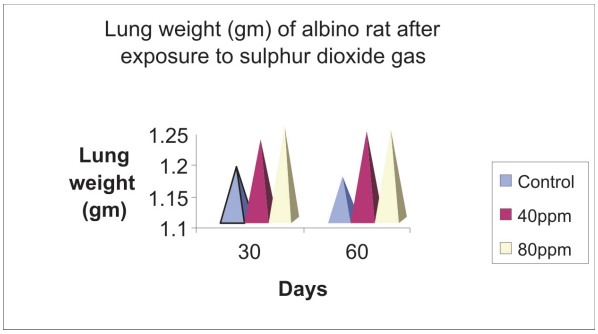

Fig. 1

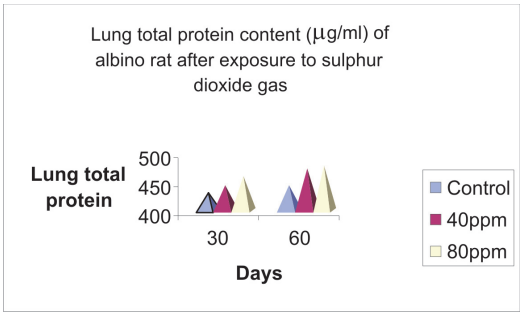

Fig. 2

Haider (1985), Lehnert *et al.* (1994) and Jonasson *et al.* (2017) have also supported the present findings.

In the present investigation total protein increases significantly after exposure to sulphur dioxide gas. An elevation in total protein is the result of pulmonary inflammation in rats caused by toxic action of gas. Inflammatory state in the lung tissue increases whole lung protein initially by influx of plasma into the lung and later by cell proliferation which results pulmonary edema in rats. Destroyed type-I epithelial cells are replaced by type-II epithelial cells and protein synthesis particularly more active in these cells. In support of present findings, Gong *et al.* (2001) have stated that an elevation in total protein content caused by pulmonary inflammation after exposure to sulphur

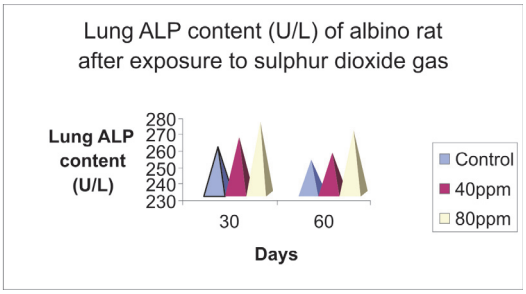

Fig. 3

Table 1. Lung weight (gm), total protein (µg/ml) and alkaline phosphatase (U/L) of albino rat after exposure to sulphur dioxide gas

Parametrs	Exposure days	Experimental sets (10)		
		Concentrations		
		Control Set (10)	40 ppm	80 ppm
		Range (Mean ± S.Em)	Range (Mean ± S.Em)	Range (Mean ± S.Em)
Lung weight	30	1.020 – 1.302 (1.186 ± 0.024)	1.100 – 1.320 (1.229 ± 0.018)*	1.180 – 1.340 (1.250 ± 0.019) *
	60	1.028 – 1.236 (1.171 ± 0.022)	1.180 – 1.310 (1.241 ± 0.019)**	1.146 – 1.340 (1.245 ± 0.018)**
Total protein	30	377.77 – 455.55 (430.00 ± 9.15)	394.44 – 472.22 (442.22 ± 8.73)*	411.11 – 494.44 (458.33 ± 7.69) **
	60	383.33 – 483.33 (443.33 ± 9.61)	427.77 – 488.88 (470.00 ± 6.93)**	427.77 – 511.11 (477.22 ± 9.95)**
Alkaline phosphatase	30	234 – 290 (258.3 ± 5.93)	238 – 293 (264.0± 6.45)*	242 – 292 (273.5 ± 6.65)*
	60	230 – 282 (250.3 ± 5.44)	239 – 288 (254.6 ± 5.09)*	245 – 299 (268.3 ± 6.13)**

ppm - parts per million
S.Em - Standard Error of mean
(10) - No of observations
_ - Increase

* Non-significant ($p>0.05$)
** Significant ($p<0.05$)

dioxide gas. Muller *et al*. (2001) and Czekaj *et al.* (2002) have also reported an increase in lung total protein due to influx of serum into the alveolar space via capillary leakage. Similar views regarding an increase in lung total protein content have been given by Azouley *et al.* (1977); Mustafa *et al.* (1980) and Elsayed *et al*. (1994) who reported replacement of type I cells by proliferating type II cells due to increase in lung injury in rats after exposure to nitrogen dioxide gas.

Alkaline phosphatase increases significantly after exposure to sulphur dioxide gas. An increase in alkaline phosphatase is the indication of pulmonary injury and increases in type-II epithelial cells in rat. The alkaline phosphatase found in type-II cells and these cells proliferates and differentiate to restore in the epithelium due to toxicity of sulphur dioxide. Similar to the present findings, Meulenbelt *et al.* (1992) have reported an increase in alkaline phosphatase activity in the lung of albino rat due to proliferation of type II cells after exposure to nitrogen dioxide gas. Alarie *et al.* (1975) and Kheirouri *et al.* (2020) have also supported the present findings.

A significant increase in lung weight, total protein and alkaline phosphatase is due to pulmonary inflammation, caused by toxic action of sulphur dioxide gas. The toxicity of sulphur dioxide gas is dose and time dependent.

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Conflict of interest

The author declares no conflict of interest.

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