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ATTENUATION OF SERUM LIPID PROFILE BY ORAL SUPPLEMENTATION OF *ALOE VERA* LEAF PULP EXTRACT IN SO_2 EXPOSED ALBINO RATS

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A B S T R A C T

Present study is conducted to evaluate the curative effects of A. vera on the serum lipid profile in albino rat after SO_2 gas exposure. The rats were grouped in four sets- control set (1) was kept in control conditions, control set (2) was exposed to ambient air with oral administration of A. vera leaf pulp extract (200mg/kg/b.wt.) for 30 and 60 days while experimental set (3) was exposed to 80ppm of SO_2 gas 1h/d for 30 and 60 days and experimental set (4) was exposed to 80ppm of SO_2 gas 1h/d with oral administration of A.vera leaf pulp extract (200mg/kg/b.wt.) for 30 and 60 days. The results showed marked elevation in serum cholesterol ($p<0.001$), LDL ($p<0.01$), VLDL ($p<0.01$), triglyceride ($p<0.01$) level and decrease in serum HDL ($p<0.001$) after exposure to 80ppm of SO_2 gas in comparison to control rats, while after oral administration of A. vera, restored the cholesterol, triglyceride, LDL, VLDL, and HDL level have reported in serum in comparison to SO_2 exposed rats. The reduction in toxic effects of SO_2 is due to anti-oxidative activity of A. vera in albino rat.

Keywords

Albino rat
SO_2
Serum Lipid profile
Aloe vera

INTRODUCTION

Aloe vera is a semi-tropical, stemless succulent plant belonging to the family Liliaceae (Dapper *et al.,* 2007). *A. vera* contains vitamins, minerals, amino acids, saccharides, anthraquinones and enzymes. It has anti-oxidative, anti-inflammatory and anti-fungal properties. (Hamman, 2008; and Warawatgaon *et al.,* 2014). Aloesin, derivative of *A. vera* posses strong OPPH radical and superoxide anion, having scavenging activities (Yagi *et al.,* 2002; and Yagi and Takeo, 2003).

Sulphur dioxide is the colourless most poisonous and irritating gas with penetrating and pungent smell, which occurs in atmosphere in the large quantity (Agarwal *et al*., 2009). In the environment, its presence is due to both natural and anthropogenic activities. SO_2 plays an important role in photochemical smog formation. It also reacts with water, oxygen and other materials in the air to form sulphur containing acids. The presence of SO_2 in low density in city air and in high density in industrial environment was found (Bai and Meng 2005; Meng and Liu 2007; Rajaii *et al*., 2008).

SO_2 is the known source of oxidants, generate free radicals, involved in the vascular system. Lipid is an essential component of all cells and is involved in numerous biological processes. Lipids serve as the reservoir of energy because of their higher caloric value and storage properties in tissue. Blood lipids are well known factors associated with the development of cardiovascular disease. Fat bullets up more easily on arterial wall, damaged by SO_2 gas and alter the level of lipoprotein due to lipid peroxidation (Meng 2003; Meng *et al.*, 2004; Tomar *et al.*, 2005; Zhao *et al.*, 2008). Present investigation was made to investigate the curative effect of *A. vera* on serum lipid profile in SO_2 exposed albino rat, *Rattus norvegicus* (Berkenhout).

Materials and Methods

Animals: Adult healthy male wistar albino rats of weight ranging from 150-195g were kept in polypropylene cages. Inbred colony of albino rats were maintained at animal house of zoology department in

standard condition of temperature 25±2°C and relative humidity 50±0.5% and desired light dark cycle (12-12 hrs.). The rats were fed on standard laboratory animal diet commercial food pellets, golden feed, New Delhi and water *ad libitum*. Experimental animals acclimated for one month prior to experiment. The albino rats were reared in the animal house as per directions of ethical committee of zoology department, Dr. B.R. Ambedker University Agra.

Generation of SO_2: 80ppm SO_2 gas was generated by controlled action of 5% sulphuric acid on sodium sulphite in a sulphur dioxide generator (Singh and Rao, 1979). Rats were exposed in fumigation chamber (AP 07 model SFC 120), Standard Appliances, Varanasi.

Preparation of *Aloe vera* aqueous extract of leaf pulp: Fresh leaves of *Aloe vera* were collected from the Dewan farms, Barara, Agra. The thick epidermis was selectively removed and inner colourless mucilaginous pulp was taken. The fresh pulp (1kg) of *Aloe vera* grinded in spice grinder and extracted with one litre of distilled water and kept with magnetic stirrer in cold room temperature for 48 hours. The suspension was filtered by whatman No. 1 filter paper and residue was used for experimentation (Dapper *et al*., 2007).

The dose of *Aloe vera* extract (200mg/kg b.wt./day) was administered in rats by oral gavage. The dose was selected by as guideline as per traditional medicinal system (WHO, 2001).

Experimental design: The rats were randomly divided in to control sets (1) and experimental sets (2&3) of ten rats each.
Control set (1): without SO_2 Exposure
Experimental set (2): Exposed to SO_2 gas (80 ppm/hr./day) for 30 and 60 days
Experimental set (3): Exposed to SO_2 gas (80 ppm/hr./day) along with oral administration of freshly prepared aqueous extract of *Aloe vera* (200 mg/kg b.wt./day) for 30 and 60 days.

Collection of blood samples: After stipulated exposure period rats of control and experimental groups were sacrificed and blood samples were collected from the ventricles of heart for the estimation of serum lipid profile.

Lipid profile test: Serum cholesterol was estimated by Roeshalu *et al*., (1974), serum triglyceride by Scheltter and Nussel (1975), HDL by Wybenga and Pileggi (1970), LDL and VLDL by Friedwald *et al*., (1972).
Statistical analysis: The results were expressed as mean ± S.Em.were signified by using student`s 't' test. The statistical calculations were carried out by using one way of ANOVA with the help of computer statistical programme kpky plot (version-3.0)

Results and discussion
The values of serum lipid profile in control and experimental sets for 30 and 60 days are given in Table (1&2).
In the present study, a significant increase in serum cholesterol ($p<0.001$), serum triglyceride ($p<0.01$), LDL ($p<0.01$) and VLDL ($p<0.01$) with corresponding decrease in HDL level ($p<0.001$) have been observed after exposure to 80ppm SO_2 in relation to control set (1).

Oral administration of *Aloe vera* leaf pulp extract (200 mg/kg b.wt./day) significantly decrease the serum cholesterol level ($p<0.01$), serum triglyceride ($p<0.05$), LDL ($p<0.01$) and VLDL ($p<0.05$) with corresponding increase level in HDL ($p<0.01$) in SO_2 exposed albino rats.

An elevation in serum cholesterol, serum triglyceride, LDL and VLDL level with a corresponding decrease in HDL level is the indication of cell membrane lipid peroxidation due to generation of free radicals after inhalation of sulphur dioxide gas. The process lead to LDL – oxidation by free radicals in the pathogenesis of atherosclerosis through oxidation of low- density lipoprotein that damage the arterial walls (Harman, 1992, Meng, 2003 and Thumus *et al*., 2005). SO_2 increases lipid peroxidation of cell membranes and interferes with antioxidative process in terms of decreasing the level of superoxide dismutase, catalase and glutathione peroxidase (Gumuslu *et al*., 1998; Meng *et al*., 2003). The present investigation is also affirms the findings of Chattopadhyay and Chattopadhyay (2008) who also reported significant increase in cholesterol triglyceride, LDL, VLDL, level with decrease in HDL level due to lipid peroxidation in female rats and SO_2 induced lipid peroxidation in mice (Zhao *et al*., 2008).

The elevation in serum total cholesterol level in rats may be correlated with liver dysfunction due to toxic action of SO_2 gas. Liver dysfunction leads to the inhibition of cholesterol level, of which it is the precursor resulting in hypercholesterolemia (Murray, 1990) in albino rats due to toxic effects of SO_2 (Tansy *et al*., 1980 ; Singh and Agarwal, 1998; Agarwal and Sharma, 1999).

Lipid peroxidation is frequently used as an indication of tissue oxidative stress as a result of which generation of free radicals increases which attacks on the cell membrane, leading to increased membrane permeability and cellular damage. The Increased

oxidative stress and generation of free radicals can result in the modification of LDL to oxidized LDL that could lead to atherosclerotic lesion (Kharb and Singh, 2000). The free radicals play an important role in pathogenesis of atherosclerosis via oxidation of LDL that damage the arterial wall (Harman, 1992).

After oral administration of aqueous extract of *A. vera* decreased level in serum cholesterol, serum triglyceride, LDL and VLDL, while an increase in HDL level in albino rats could be correlated with curative action against deleterious effects of SO_2 gas by scavenging the reactive oxygen species, there by strengthening the antioxidants defence mechanism.

Similarly, Rajasekaran *et al*., (2005[a&b] and 2006) and Yagi *et al.,* (2009) reported oral administration of *Aloe vera* extract significantly reduced the level of plasma cholesterol, triglycerides, phospholipids, free fatty acids, LDL and VLDL- cholesterol, where as levels of HDL-cholesterol was significantly increased in diabetic rats.

Administration of *Aloe vera* reduces total serum cholesterol, triglycerides and LDL in patients of hyperlipidaemia (Wang *et al*., 2000; Lim *et al*., 2003). Restored level of lipid peroxidation and decreased level of triglyceride have also been observed after oral administration of *Aloe vera* leaf pulp extract due to aloeresin derivatives (Can *et al*., 2004) in rats and (Chandan *et al*., 2007) in mice.

The findings of the present study are also supplicated by the observations of Moniruzzaman *et al.,* (2012); Sharma *et al.,* (2013); Mohepatra *et al.,* (2013) and Mude, (2015) that oral administration of *Aloe vera* extract significantly reduces plasma cholesterol, triglycerides, LDL and restores the plasma HDL in diabetic rats. Present study suggests that oral administration of aqueous extract of *A. vera* have more potential in restoration of lipid parameters elevated by SO_2 gas in albino rats.

References

- Dapper, D.V., Achinike, P.N. and Gwotmut, M.D. 2007.The effect of *Aloe vera* (gel) on clotting time, prothrombin time and plasma fibrinogen concentration in albino wistar rats. Port Harcourt Medical Journal; 2(1): 56-60.
- Hamman, J.H. 2008. Composition and applications of *Aloe vera* leaf gel. Molecules, 13: 1599-1616.
- Yagi, A., Kabash, A. Okamurs, N., Haraguchi, H., Moustafa, S.M. and Khalifa, T.I. 2002. Antioxidants, free radical scavenging an anti- inflammatory effects of aloesin derivatives in *Aloe vera*. Planta. Med., 68: 957-960.
- Yagi, A .and Takeo, S. 2003 anti inflammatory constituents, aloesin and aloemannan in aloe species and effect of tanshinon VI in salaivamiltiolrrhiza on heart. YakugakuZasshi, 74:517 – 532.
- Agarwal, A., Yadav, M. and Goyal, P.K. 2009. Sulphur dioxide gas induced histopathological changes in liver of albino rat. J. Ecophysiol. Hlth., 9: 55-58.
- Agarwal, A. and Sharma, P. 1999. Effect of sulphur dioxide on total cholesterol level in the blood of albino rats. J. Environ. Bio., 20: 335-338.
- Bai, J. and Meng, Z. 2005. Expression of apoptosis related genes in liver from rats exposed to sulphur dioxide. Toxicology, 216: 253-260.
- Can, A., Akev, N., Ozsoy, N., Bolkent, S., Arda, B.P., Yanardag, R. and Okyar, A. 2004. Effect of *Aloe vera* leaf gel and pulp extract on the liver in type-II diabetic rat models. Biol. Pharm. Bull., 25(5): 694-698.
- Chandan, B.K., Saxena, A.K., Shukla, S., Sharma, N., Gupta, D.K., Sur,i K.A., Suri, J., Bhadauria, M. and Singh, B. 2007. Hepatoprotective potential of *Aloe barbadensis* Mill. Against carbon tetrachloride induced hepatotoxicity. J. Ethnopharmacol., 111(3): 560-566.
- Chattopadhayay, K. and Chattopadhayay, B.D. 2008. Effect of nicotine on lipid profile peroxidation and antioxidant enzyme in female rats with the restricted dietary protein. Indian J. Med. Res., 127: 571-576.
- Friedwald, W.T., Levy, R.I. and Fredrickson, D.S. 1972. Estimation of the concentration of low density lipoprotein cholesterol in plasma without use of the preparative ultracentrifuge.Clin. Chem., 18: 449.
- Gumuslu, S., Akbas, H., Aliciguzel, Y., Agar, A., Kuckatay, V. and Yargicoglu, P. 1998. Effect of sulphur dioxide inhalation on antioxidant enzyme activities in rat erythrocytes. Ind. Health, 36: 70-73.
- Harman, D. 1992. Role of free radicals in ageing and diseases. Ann. N. Y. Acad. Sci., 673: 126-141.
- Lim, B.O., Seong, N.S., Chove, R.W., Kim, J.D., Lee, H.Y., Kim, S.Y., Jeon, T.I. and Park, D.K. 2003. Efficacy of dietary *Aloe vera* supplementation on hepatic cholesterol and oxidative status in aged rats. J. Nutr. Sci. Vitamonel., 49(4): 292-296.
- Meng, Z. 2003. Oxidative damage of sulphur dioxide on various organs of mice: Sulphur dioxide is a systemic oxidative damage agent. Inhal.Toxicol., 15 (2): 181-195.

- Meng, Z. and Liu, Y. 2007. Cell morphological ultra-structural changes in various organs from mice exposed by inhalation to sulphur dioxide.Inhal.Toxicol., 19: 543-551.
- Meng, Z., Qin, G., Zhang, B. and Bai, J. 2004. DNA damaging effects of sulphur dioxide derivatives in cells from various organs from mice. Mutagenesis, 19: 465-468.
- Murray, R.K., Mayes, P.K., Granner, D.K. and Roduell, Y.W. 1990. Harpers Biochemistry 22nd edition, Prentice Hall International Inc., 678pp.
- Rajaii, F., Khaki, A.A., Khaki, A., Knorshid, F., Borhani, N., Jfraii, H., Haghdust, H. and Gneibi, N. 2008.Histopathological effects of sulphur dioxide in mouse liver following the chronic and acute exposure. J. Bio. Sci., 8(7): 1241-1245.
- Rajasekaran, S., Ravi, k., Sivagnanam, K. and Subramanian, S. 2006. Beneficial effects of *Aloe vera* leaf gel extract on lipid profile status in rats with streptozotocin diabetes. Clinical and Experimental Pharmacology and Physiology, 33: 232-237.
- Rajasekaran, S., Sivanganam, K. and Subramanian, S. 2005[a]. Antioxidant effect of *Aloe vera* gel extract in streptozotocin diabetes in rats. Pharmacol. Rep., 57: 90-96.
- Rajasekaran, S., Sivanganam, K. and Subramanian, S. 2005[b]. Modulatory effect on oxidative stress in rats treated with streptozotocin. J. Pharm. Pharmacol., 57: 241-246.
- Roeschlau, P., Bernt, E. and Grube,r W.A. 1974. Clin. Chem. Clin. Biochem., 12: 226.
- Schettler, G. and Nussel, E. 1975. Determination of triglycerides ARB. Med. SO_2 Med. Prav.Med., 10: 25.
- Singh, N. and Rao, D.N. 1979. Studies on the effect of sulphur dioxide on alfaalfa plants specially under conditions of natural precipitation. Ind. J. Air, Poll. Contr., 2(2): 55-69.
- Singh, S. and Agarwal, A. 1998. Effect of Sulphur dioxide inhalation on Parakeets serum cholesterol and hydrolytic enzymes. Indian J. Environ. Toxicol., 8(1): 12-14.
- Tansy, M.F., Kendell, F.M., Famtasia, J., Londim, W.E., Oberly, R. and Sherinan, W. 1980. Acute and subchronic toxicity studies of rats exposed to vapours of Methylmercaptan and other reduced sulphur compounds. J. Toxicol. Environ. Health, 8: 71-88.
- Tomar, A., Etlik, O. and Gundogan, N.U. 2005. Hyperbaric oxygenation and antioxidant vitamin combination reduces ischemia- reperfusion injury in a rat epigastric island skip-flap model. J. Basic Clin. Physiol. Pharmacol., 4: 275-278.
- Wang, D.X., Yang, G.L., Wang, L.Y. and Song, X.R. 2000. Determination of the active components in Chinese herb *Aloe vera* L. var. Chinesis (Haew) Berger by capillary zone electrophoresis. Se Pu., 18: 423-425.
- World Health Organization (WHO). 2001. Quality control methods for medicinal plants. WHO, Geneva, Switzerland, 115-129.
- Wybenga, D.R. and Pileggi. 1970. *In vitro* determination of cholesterol and HDL cholesterol in serum/plasma. Clin. Chem., 16: 980.
- Yagi, A., Hegazy, S., Kabbash, A. and Abd- El Wahab, E. 2009.Possible hypoglycemic effect of *Aloe vera* L. high molecular weight fractions on type-2 diabetic patients. Saudi Pharmaceutical Journal, 17(3): 210-217.
- Zhao, H., Xu, X., Na, J., Hao, L., Huang, L., Li,G. and Xu, Q. 2008. Protective effects of salicylic acid and vitamin C on sulphur dioxide induced lipid peroxidation in mice. Inhalation Toxicology, 20(9): 865-871.
- Kharb, S. and Singh, G. P. 2000. Effects of smoking on lipid profile, lipid peroxidation and antioxidant status in normal subjects and in patients during and after acute myocardial infarction. Clin. Chem. Acta., 302: 213-219.
- Werawatganon, D., Linlawan, S., Thanapiram, K., Klaikeaw, N., Rerknimitr, R. and Siriviriyakul, P. 2014. *Aloe vera* attenuated liver injury in mice with acetaminophen- induced hepatitis. BMC Complementary and Alternative Medicine, 14(229) :1-10
- Sharma, B., Kumar, S.S., Siddiqui, S., Ram, G.D. and Choudhary, M. 2013. Ameliorative effects of aqueous leaf extract of *Aloe arborescens*on anti-hyperglycaemic and anti-hyperlipidaemia alterations in alloxan-induced diabetic mice. J. Investig. Biochem., 2(2): 71-76
- Mude, R.N. 2015. Regulation of Type-II diabetes treatment with *Aloe vera* extract on lipid metabolism status in liver Alloxan induced male rats. World J. Pharmaceu. Res., 4(10): 1219-1232
- Mohapetra, S., Rath, B., Maharana, C.C., Pradhan, S. and Tripathy, S. 2013. Hypoglycaemic, hypolipidemic properties of *Aloe vera* in streptozotocin induced diabetic rats. Int. J. Biol. Med. Res., 4(1): 2783-2787
- Moniruzzaman, M., Rokeya, B., Ahmed, S., Bhowmik, A., Khalil, M.I. and Gan, S.H. 2012. *In vitro* antioxidant effects of *Aloe barbadensis* Miller extracts and the potential role of these extracts as antidiabetic and antilipidemic agents on streptozotocin –induced Type-2 diabetic model rats. Molecules, 17: 12851-12867

Table- 1: Effect of *Aloe vera* on SO_2 induced alterations on various lipid indices (mg/dl) after 30 days exposed rats.

Groups	Treatment	30 days (Mean ± S.Em)				
		Cholesterol	Triglyceride	HDL	LDL	VLDL
Experimental set-1 (5)	Unexposed	74.84± 1.99	59.04± 3.14	39.21± 1.33	23.82± 3.09	11.81± 0.64
Experimental set-2 (5)	80 ppm SO_2 gas	87.29± 2.62	69.72± 1.50	32.24± 2.34	41.11± 4.59	13.94± 0.30
Experimental set-4 (5)	80ppm SO_2 gas + *Aloe vera*	75.04± 2.17	64.23± 3.76	39.16± 1.86	23.03± 3.61	12.85± 0.75

Table- 2: Effect of *Aloe vera* on SO_2 induced alterations on various lipid indices (mg/dl) after 60 days exposed rats.

Groups	Treatment	60 days (Mean ± S.Em)				
		Cholesterol	Triglyceride	HDL	LDL	VLDL
Experimental set-1 (5)	Unexposed	73.13± 2.29	60.42± 2.88	40.65± 3.00	20.39± 5.46	12.08± 0.58
Experimental set-2 (5)	80 ppm SO_2 gas	91.54± 2.70	77.84± 2.51	26.95± 1.53	49.01± 4.06	15.57± 0.50
Experimental set-4 (5)	80ppm SO_2 gas + *Aloe vera*	74.18± 2.30	64.14± 3.37	38.95± 3.03	22.41± 3.94	12.83± 0.67