Summary and Conclusion

Pollution with lead salt is a health hazard to modern man and its induced damages have significant impacts on the socioeconomic development of individual society. Prevention or curing of lead salt induced toxicity would constitute a major achievement in human welfare. The current therapeutic approach to lead toxicity is to increase the excretion of lead by chelation with certain complex compounds but their side effects are numerous. Recent studies suggest that oxidative stress is a potential contributor to lead toxicity, and it disrupts directly or indirectly the delicate pro oxidant/anti oxidant balance in the cells. Thus there has been increased interest in the treatment of lead toxicity by using various products of medicinal plants with antioxidant properties for reducing reactive oxygen species (ROS) in vivo and their induced tissue injury. Very little work is so far carried out by other people for the detoxification of health hazards caused by heavy metals like lead by supplementing the daily diet with nutraceuticals. The only exception is the introduction of garlic compound “satlal” by a Bulgarian scientist Petkov. Thus we have decided to do something at our level with allium oils and this is the aim and scope of selecting this research problem. At present the most commonly used chelators are those such as calcium disodium ethylene diamine tetra acetic acid (CaNa$_2$EDTA; versenate), meso-2,3-dimercaptosuccinic acid (DMSA; succimer), sodium 2,3-dimercapto-1-propanesulfonate(DMPS) and penicillamine. Any strategy that protects or retards the progress of lead induced damage has a significant health impact. The study was aimed at evaluating the counter acting effects of polar and nonpolar fractions of garlic and onion oils as compared to Vitamin E on such damages produced by feeding daily lead acetate solution at definite doses to the rats for a month.
1. Biochemical effects of allium oils as compared to vitamin E in rats for one month feeding

The biochemical effects of feeding the polar and non polar fractions of garlic and onion oils and vitamin E in rats for a month without lead acetate were assessed by evaluating many parameters such as Hb, RBC and WBC in blood and the activities of serum and tissue ALT, AST, catalase, SOD, glutathione reductase, glutathione peroxidase and also the levels of TBARS, GSH and the lipid profile such as total cholesterol, TAG and LDL. Vitamins E and C and HDL cholesterol in serum were also measured. Non toxic nature of the allium oils and vitamin E at fixed doses were confirmed by histopathological studies on heart, liver and kidney of the test animals.

Results indicates the following findings

- Hb level and WBC count increased slightly above the normal and RBC count significantly increased in rats fed with polar and non polar fractions of garlic and onion oils as well as vitamin E when compared to that of the normal group of rats.
- When serum ALT and AST activities slightly decreased below the normal and liver, heart and kidney tissue ALT and AST activities increased slightly higher in rats fed with polar and non polar fractions of garlic and onion oils as well as vitamin E when compared to that of the normal group of rats.
- Activities of antioxidant enzymes in serum, liver, heart and kidney tissues such as catalase, SOD, glutathione reductase and glutathione peroxidase and the levels of non enzymatic antioxidants such as serum and tissue GSH and also that of serum vitamin E and C were raised significantly in rats fed with polar and non polar fractions of garlic and onion oils as well as vitamin E when compared to that of the normal group of rats.
- On the contrary levels of serum, liver, heart and kidney tissue TBARS decreased significantly in rats fed with polar and non polar fractions of
garlic and onion oils as well as vitamin E when compared to that of the normal group of rats.

- Similarly levels of serum, liver, heart and kidney tissue total cholesterol, TAG and serum LDL cholesterol decreased significantly by feeding the oils in the above groups. On the other hand the serum HDL cholesterol increased significantly in rats fed with polar and non polar fractions of garlic and onion oils as well as vitamin E when compared to that of the normal group of rats.

- However in rats fed with polar and non polar fractions of garlic and onion oils and vitamin E did not alter normal architecture and cell structure of liver, heart and kidney tissues as compared to that of the tissues of normal rats.

2. Curative effects of the allium oil fractions as compared to vitamin E in lead acetate fed rats

The curative effects of polar and non polar fractions of garlic and onion oils and vitamin E in lead acetate fed rats were also assessed by evaluating all the above said parameters in blood, serum and tissues. In addition to the above level of serum lead and also blood levels of δ - ALAD were also measured in all the 8 groups of rats mentioned in the table. Histopathological analysis of liver, heart and kidney tissues of the rats was also carried out. The oxidative damages produced by lead poisoning due to daily consumption of lead acetate solution in rats were counteracted satisfactorily by feeding various fractions of allium oils in a gradational manner as shown below, when compared with vitamin E fed group in the results.

Results also indicate the following findings.

- Level of serum lead increased very high significantly in rats fed with lead acetate solution and later on treatment with polar and non polar fractions of garlic and onion oils and vitamin E showed significant decreases of serum lead level towards normal.
Activity of d-ALAD decreased very high significantly in rats fed with lead acetate solution and later on treatment with polar and non polar fractions of garlic and onion oils and vitamin E showed significant increases of serum d-ALAD activity towards normal.

Hb level, RBC and WBC counts decreased very high significantly in rats fed with lead acetate solution and later on treatment with polar and non polar fractions of garlic and onion oils and vitamin E they reversed the above bad effects of Pb salt and the rats showed significant increases of the above parameters towards normal.

Serum ALT and AST activities increased very high significantly and liver, heart and kidney tissue ALT and AST activities decreased very high significantly in rats fed with lead acetate solution and later on treatment with polar and non polar fractions of garlic and onion oils and vitamin E they reversed the above deleterious effects of lead and the rats showed significant decreases of serum AST and ALT and increases of tissues ALT and AST activities towards normal.

Activities of antioxidant enzymes in serum, liver, heart and kidney tissues such as catalase, SOD, glutathione reductase and glutathione peroxidase and also the levels of non enzymatic antioxidants such as serum and tissue GSH, serum vitamin E and C were lowered very high significantly in rats fed with lead acetate solution. However on treatment with polar and non polar fractions of garlic and onion oils and vitamin E the deleterious effects of lead salt were reversed by them and the assessment showed significant increases of these antioxidant enzymes and non enzymatic antioxidants.

Again levels of serum, liver, heart and kidney tissue TBARS increased very high significantly in rats fed with lead acetate solution and later on treatment with polar and non polar fractions of garlic and onion oils and vitamin E they reversed such deleterious effects of lead salt and the rats showed significant decreases of serum and tissue TBARS level.
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of garlic and onion oil (PFG and PFO) and vitamin E reversed all these alterations in values.

- Serum ALT and AST activities increased very high significantly in rats fed with lead acetate solution but their liver, heart and kidney tissue ALT and AST activities decreased at the same time very high significantly. However on simultaneous feeding of two very active polar fractions of garlic and onion oils (PFG and PFO) and vitamin E helped to decrease the elevated serum ALT and AST activities and increase the lowered tissues ALT and AST activities as a result of treatment.

- Lead acetate solution fed rats showed very highly significant decreases in serum, liver, heart and kidney tissue anti oxidant enzymes such as catalase, SOD, glutathione peroxidase and glutathione reductase activities and also decreases in the levels of non enzymatic antioxidants such as GSH, vitamin C and E levels. However on simultaneous feeding of polar fractions of garlic and onion oils and vitamin E they reversed all these values towards normal.

- Lead acetate administration also lead to increased levels of lipid peroxidation product such as TBARS and lipid profile such as serum and tissues TAG, total cholesterol and serum LDL cholesterol very high significantly, while serum HDL cholesterol decreased very high significantly in rats as compared to that of the normal control rats. Simultaneous feeding of very active polar fractions of garlic and onion oils and vitamin E showed very highly significant decreases of serum and tissue total cholesterol, TAG and LDL cholesterol levels and on the contrary they showed very highly significant increases in the level of serum HDL cholesterol.

- Lead acetate administration also lead to cellular changes such as necrosis in the liver, heart and kidney tissues but on simultaneous feeding of very active polar fractions of garlic and onion oils as well as vitamin E they decreased the necrosis of the different tissue cells and reversed tissues to normal appearance.
In vitro studies on the protective action of allium oil fractions against lead acetate induced hemolysis of RBC in normal saline have been evaluated and the following findings are observed.

- Even low concentration of lead acetate solution (0.2mg%) lead to a significant hemolysis of RBC
- Addition of low concentration of lead acetate solution along with different fractions of water soluble and insoluble portions of allium oils to the 5% RBC suspensions in different test tubes significantly reduced lead acetate induced hemolysis to varied extents. Of these samples the polar fraction of garlic oil showed the maximum protection of RBC as compared to the non polar fraction and other samples of the oils from lead acetate induced hemolysis.

**SUMMARY**

In summary our study conclude that supplementation of polar and non polar fractions of garlic and onion oils and vitamin E along with normal feeding of rats improved the functioning of their normal cells and tissues and they are further considered to be safe for use and found to cure or prevent lead salt induced toxicity on feeding to rats by inhibiting free radical generation and enhancing the antioxidant enzymes activities and reducing lipid peroxidation. These biochemical and histopathological corrections by the oil fractions suggest that an important role was played by them as compared to vitamin E in alleviating the oxidative stress in the lead salt induced toxicity in rats. These may be also due to the capacity of the allium oils as found with Satlal with others in removing the lead salt from the body of the rats possibly as lead sulfide. All these results suggest that polar fraction of garlic oil is more potent than all other fractions of the garlic and onion oils and also the vitamin E. The order of efficacy was PFG>PFO>NPFG>NPFO ≥ vitamin E. In the light of our observations polar fractions of allium oils have significant detoxifying and
antioxidant activities both *in vivo* and *in vitro* against lead toxicity and that garlic could be considered as a part of our regular diet in the areas, where we may have chances of exposure to lead occupationally or environmentally.