SUMMARY

The present work entitled “Study of protective effect of *Camellia sinensis* (L.) O. Kuntze on cadmium toxicity in albino rats” emboidies work on protective effect of aqueous extract of *Camellia sinensis* against cadmium toxicity.

During the present project protective effects of *Camellia sinensis* were tried to work out against cadmium toxicity on different body organs such as liver, kidney, brain, testes, muscles and blood. For this purpose two doses of cadmium were selected for cadmium control groups. Similarly two doses of aqueous extract of *C. sinensis* were used.

Experimental animals were co-treated with cadmium and aqueous extract of *C. sinensis*. To study whether the effect of aqueous extract of *C. sinensis* was permanent or temporary, two groups of rats were kept on normal diet for 15 days after co-treatment with different doses of cadmium and *C. sinensis* extract for 15 and 30 days. Normal control groups and cadmium control groups were also maintained throughout the study with all doses and durations of the experiment.

The work is presented in the form of six chapters -

1) The first chapter is introduction. In the chapter uses and properties of *C. sinensis* are mentioned. Different varieties of tea prepared from *C. sinensis* leaves are discussed and constituents of green tea are mentioned.

*C. sinensis* leaves are processed in three basic forms, 78% is black tea, which is usually consumed in the western countries, 20% is green tea which is commonly consumed in Asian countries such as China and Japan, as well as a few countries in North Africa and the Middle East, and 2% is Oolong tea, which is consumed mainly in Southern China.

Although *C. sinensis* contains over 2000 components, the flavanol polyphenolic compounds are the most abundant. These compounds are commonly known as catechins and include epigallocatechin-3-gallate (EGCG), epicatechin gallate (ECG) and epicatechin (EC).
After introduction of the green tea, sources of cadmium pollution in the environment are mentioned. Methods and modes of exposure of human beings to cadmium are also described. In brief harmful effect of cadmium on human beings are also given.

Cadmium is a wide spread industrial pollutant that is produced during the manufacture of batteries, paints, plastics and fertilizers. Anthropogenic sources of cadmium to the environment are: refining copper and nickel smelting and fossil fuel combustion. Natural sources of cadmium to the atmosphere are: volcanic activity, forest fires and wind blown transport of soil particles. It is important to note that the anthropogenic source of cadmium add 3-10 times more cadmium to the atmosphere than natural sources.

Principal uses and environmental sources of cadmium include electroplating, polyvinyl chloride stabilizer and nickel-cadmium battery production.

Human beings are exposed to cadmium by breathing contaminated workplace air (battery manufacturing, metal soldering or welding), eating foods containing it; low levels occur in all foods (highest in shell fish, liver and kidney), by inhaling cadmium in cigarette smoke (doubles the average daily intake), by drinking contaminated water, by breathing contaminated air near the burning of fossil fuels or municipal wastes.

2) Second chapter consists of materials and methods, in which collection of material, techniques applied for extraction and experimental design are described. Processed leaves of C. sinensis were used for preparing aqueous extract. The extract was prepared with the help of soxhelet apparatus at controlled temperature.

Male albino rats of Wistar strain were selected for the experiment. Experimental animals were divided into 2 sets. In set I cadmium was given at a rate of 1 mg/100 g. body weight to cadmium control group and to C. sinensis extract group also. In set II cadmium was given at a dose of 2 mg/100 g. body weight to cadmium control group and to C. sinensis treated groups also. Similarly two doses of aqueous extract of C. sinensis were used i.e. 2 mg and 4 mg/100 g.
body weight. Two durations were fixed for the treatment, 15 days and 30 days. Two groups for each dose group were kept for reversibility study where extract feeding and cadmium treatment were discontinued for 15 days after completion of the duration of treatment i.e. after 15 and 30 days respectively, to study whether the effect of aqueous extract of *C. sinensis* was permanent or temporary.

After the completion of each group and sets, the experimental animals were weighed and dissected. Liver, kidney, brain, testes and muscles were taken for biochemical analysis. Total protein, sugar, lipids, alkaline phosphatase, acid phosphatase, alanine transaminase (ALT), asparate transaminase (AST) were studied. Blood was analyzed for Hb%, TLC, DLC, RBC count, PCV, MCV, MCH, MCHC, sugar, total proteins, lipid, urea, alkaline phosphatase, acid phosphatase, serum alanine transminase (ALT) and serum asparate transaminase (AST). These organs were selected mainly on the basis of the fact that liver is the first organ to be effected by any toxicant and kidneys play important role in excretion of the toxicant.

3) The third chapter contains historical resume. The literature reviewed is divided into 2 groups. First group contains literature about green tea and some other plants having antioxidant properties. In the second group the literature about cadmium toxicity is given.

4) In the fourth chapter observations are given. It contains tables, bar diagrams and histograms of various parameters studied. Observations of initial and final body weight, liver weight, kidney weight, brain weight and testes weight are given. In bar diagrams levels of initial and final body weights and organ weights of control and treated groups are compared. Next section contains tables of biochemical parameters of liver, kidney, brain, testes and muscles. Third section contains table of haematological parameters such as Hb%, TLC, DLC, RBC count, PCV, MCV, MCH, MCHC, sugar, total proteins, lipid, urea, alkaline phosphatase, acid phosphatase, serum alanine transminase (ALT) and serum asparate transaminase (AST).
All these data are statistically analyzed and level of significance calculated. For comparison of effect of cadmium treatment, 2 mg C. sinensis dose and 4 mg C. sinensis dose, 3 D histograms are used of some parameters.

**Effects of cadmium treatment** - In both cadmium control groups (1 mg and 2 mg dose) levels of sugars and proteins are decreased and lipids were increased in all organs though level of significant was different. The level of alkaline phosphatase was decreased and level of acid phosphatase, ALT and AST was increased.

In blood level of Hb %, DLC, RBC count, PCV, sugar, total proteins and alkaline phosphatase was decreased and the level of TLC, MCV, MCH, MCHC, acid phosphatase, SGPT (ALT), SGOT (AST), total lipids and urea was increased with different levels of significance.

**Effects of 2 mg dose of aqueous extract of Camellia sinensis** - In 2 mg group of C. sinensis extract co-treated with 1 mg and 2 mg cadmium /100 g. body weight respectively, sugar and proteins were slightly decreased in comparison to normal control group but slightly increased in comparison to cadmium control group. The level of lipid was slightly increased in comparison to normal control group and slightly decreased in comparison to cadmium control group in all durations. Level of alkaline phosphatase was slightly decreased in comparison to normal control group and slightly increased in comparison to cadmium control group. Level of acid phosphatase, ALT and AST was slightly increased in comparison to normal control group and slightly decreased in comparison to cadmium control group, in all organs and all durations.

In blood, level of sugar and proteins is slightly decreased in comparison to normal control group but slightly increased in comparison to cadmium control group. The level of lipids and urea was slightly increased in comparison to normal control group and slightly decreased in comparison to cadmium control groups. The level of acid phosphatase, SGPT (ALT) and SGOT (AST) show increase in comparison to normal control group and decrease in comparison to cadmium control groups in all durations. The level of alkaline phosphatase was slightly
decreased in comparison to normal control group and slightly increased in comparison to cadmium control groups. Hb %, DLC, RBC count and PCV% were slightly decreased in comparison to normal control group and slightly increased in comparison to cadmium control groups. TLC, MCV, MCH and MCHC showed slight increase in comparison to normal control group and slight decrease in comparison to cadmium control groups.

**Effects of 4 mg dose of aqueous extract of Camellia sinensis** - In 4 mg *C. sinensis* dose group co-treated with 1 mg and 2 mg cadmium respectively, all biochemical parameters, in all organs as well as in blood were almost normal in almost all experimental animals.

In the fifth chapter various results are compared and discussed. In the first section findings of both doses and durations of cadmium treatment are discussed with the work of other researchers.

In the second section results of 2 mg dose of aqueous extract of *C. sinensis* co-treated with 1 mg dose of cadmium and 2 mg dose of cadmium are discussed and compared. These results are discussed and compared with the work of other researchers on *C. sinensis* as well as other plants or plant preparations having antioxidant properties, where ever possible.

Similarly 4 mg dose of *C. sinensis* extract co-treated with 1 mg and 2 mg doses of cadmium respectively for 15 and 30 days is also discussed and compared with the findings of 2 mg dose as well as with the findings of other researchers.

In the last section results of treatment with both doses of *C. sinensis* are compared and discussed with normal control groups as well as cadmium control groups. Here results of other researchers on antioxidant properties of *C. sinensis*, protective effect of *C. sinensis* against oxidative stress and protective effect of some other plant products against other metals and toxicants are discussed and compared.
After thorough study and discussion following conclusions were drawn-

1. Effect of cadmium is of long duration.
2. Cadmium is taken up by tissues and accumulated and causes toxicity by forming free radicals by generating reactive oxygen species and modifying the enzyme activity.
3. Effect of aqueous extract of *C. sinensis* is dose dependent and it prevents tissue damage caused by cadmium.

There are following probable modes of protective effect of *C. sinensis*

i. Flavanols and polyphenols present in *C. sinensis* quenched the ROS produced by cadmium hence showing protection against cadmium toxicity.

ii. Aqueous extract of *C. sinensis* inhibits cadmium uptake and its accumulation in the tissues.

iii. Flavanols and polyphenols present in *C. sinensis* might produce their protective effect indirectly by modifying the enzyme activity thus preventing tissue damage.