

LIST OF CONTENTS

| Sr. No. | Title | Page No. |
|---------|--|---------------|
| 1. | INTRODUCTION | 1-10 |
| 2. | REVIEW OF LITERATURE | 11-76 |
| | 2.1. Radiation | |
| | 2.2. Sources of Radiation in the Environment | |
| | 2.2.1. Electromagnetic Radiation | |
| | 2.2.2. Ionizing and Non-Ionizing Radiation | |
| | 2.3. Direct and Indirect Effects of Ionizing and Non- Ionizing Radiation | |
| | 2.3.1. Stochastic and Non- Stochastic Effect of Radiation | |
| | 2.3.2. Occupational and Public Exposure to Radiation | |
| | 2.3.3. Epidemiological Studies of Human Exposure to Ionizing Radiation | |
| | 2.4. X-ray as a Source of Ionizing Radiation | |
| | 2.4.1. Biological Effects of Ionizing Radiation (Experimental Studies) | |
| | 2.5. Effects of Ionizing Radiation on Various Organs | |
| | 2.5.1. Liver | |
| | 2.5.2. Spleen | |
| | 2.5.3. Kidney | |
| | 2.5.4. Testes | |
| | 2.5.5. Effects of Ionizing Radiation on Haematological Parameters | |
| | 2.6. Antioxidants Countermeasures the Oxidative Stress Induced by Ionizing Radiation | |
| | 2.6.1. Cellular Antioxidant Defense System | |
| | 2.6.2. Synthetic and Natural Antioxidants | |
| | 2.7. Radioprotectors | |
| | 2.7.1. Synthetic and Natural Radioprotectors | |
| | 2.7.2. Plants as Radioprotectors | |
| | 2.8. <i>Aloe vera</i> | |
| | 2.8.1. Taxonomy | |
| | 2.8.2. Chemical Constituents of <i>Aloe vera</i> | |
| | 2.8.3. Structural Composition of <i>Aloe vera</i> | |
| | 2.9. Health Benefits of <i>Aloe vera</i> | |
| | 2.10. Biological Effects of Constituents of <i>Aloe vera</i> | |
| | 2.11. <i>Aloe vera</i> as an Antioxidant | |
| | 2.12. <i>Aloe vera</i> as a Radioprotector | |
| 3. | MATERIAL AND METHODS | 77-130 |
| | 3.1. Chemicals | |

- 3.1.1.** Preparation of Aqueous *Aloe vera* Gel Extract
 - 3.1.2.** Phytochemical Analysis of Aqueous *Aloe vera* Gel Extract
 - 3.2.** Antioxidant Activity of Aqueous *Aloe vera* Gel Extract (*In vitro* assay)
 - 3.2.1.** 2, 2'-azino-bis-3-ethylbenzthiazoline-6-sulphonic acid (ABTS) assay
 - 3.2.2.** 1, 1-Diphenyl-2-picrylhydrazyl (DPPH) radical scavenging assay
 - 3.3.** Quantitative Estimations for Various Components of Aqueous *Aloe vera* Gel Extract
 - 3.3.1.** Phenol sulphuric acid assay (Dubois Method) for quantification of carbohydrates
 - 3.3.2.** Determination of Total Flavonoids
 - 3.4.** Animal Treatment
 - 3.4.1.** Body Weight, Diet Intake and Water Consumption
 - 3.5.** Standardization of Aqueous *Aloe vera* Gel Extract Dose
 - 3.6.** Preparation of Serum
 - 3.7.** Preparation of Plasma
 - 3.8.** Preparation of Tissue Samples
 - 3.9.** Source of Irradiation
 - 3.9.1.** X-ray Dose Calculation by using Dose Area Product (DAP)
 - 3.10.** Standardization of X- ray Dose for Whole Body Exposure
 - 3.11.** Experimental Design for Protective Effect of Aqueous *Aloe vera* Gel Extract against X-ray Irradiation
 - 3.12.** Histopathological Studies
 - 3.13.** Reactive Oxygen Species (ROS)
 - 3.14.** Lipid Peroxidation (LPO)
 - 3.15.** Reduced Glutathione (GSH)
 - 3.16.** Glutathione Reductase (GR)
 - 3.17.** Glutathione Peroxidase (GSH-Px)
 - 3.18.** Catalase (CAT)
 - 3.19.** Superoxide Dismutase (SOD)
 - 3.20.** Glutathione-S-transferase (GST)
 - 3.21.** Lactate Dehydrogenase (LDH)
 - 3.22.** Liver Injury Markers
 - 3.22.1.** Serum Glutamate Pyruvate Transaminase activity (SGPT)
 - 3.22.2.** Serum Glutamate Oxaloacetate Transaminase activity (SGOT)
 - 3.22.3.** Bilirubin Concentration
 - 3.22.4.** Albumin Concentration

- 3.23. Renal injury markers
 - 3.23.1. Urea Concentration and Blood Urea Nitrogen (BUN)
 - 3.23.2. Creatinine Concentration
 - 3.23.3. Glomerular Filtration Rate (GFR)
- 3.24. Testicular Parameters
 - 3.24.1. Sperm Counts and Sperm Motility
 - 3.24.2. Testosterone Level
- 3.25. Protein Estimation
- 3.26. DNA Damage
 - 3.26.1. Micronucleus assay
 - 3.26.2. Chromosomal Aberration analysis
- 3.27. Haematological Parameters
 - 3.27.1. Haemoglobin (Hb)
 - 3.27.2. Red Blood Cells (RBCs)
 - 3.27.3. Total Leucocyte Counts or White Blood Cells (WBCs)
 - 3.27.4. Differential Leukocyte Counts (DLC)
 - 3.27.5. Total Platelet Counts
- 3.28. Inflammatory Markers
 - 3.28.1. Tumor Necrosis Factor (TNF- α)
 - 3.28.2. Inter Leukin-6 (IL-6)
- 3.29. Terminal Deoxynucleotidyl Transferase Mediated dUTP Nick End Labelling Assay (TUNEL)
- 3.30. DNA Isolation
 - 3.30.1. Purity and Concentration of DNA
 - 3.30.2. Agarose Gel Electrophoresis
- 3.31. Statistical Analysis

4. RESULTS

131-152

- 4.1. Phytochemical Analysis of Aqueous *Aloe vera* Gel Extract
 - 4.1.1. Antioxidant Activity of Aqueous *Aloe vera* Gel Extract
 - 4.1.2. Quantitative Estimation of Various Components of Aqueous *Aloe vera* Gel Extract
 - 4.1.3. Trace Elements in Aqueous *Aloe vera* Gel Extract
- 4.2. Standardization of Aqueous *Aloe vera* Gel Extract Dose
 - 4.2.1. Effect of Various Doses of Aqueous *Aloe vera* Gel Extract on Body Weight, Diet Intake and Water Consumption
 - 4.2.2. Histopathology of Liver
 - 4.2.3. Histopathology of Spleen
 - 4.2.4. Histopathology of Kidney
 - 4.2.5. Histopathology of Testes

- 4.3.** Effect of Various Doses of Aqueous *Aloe vera* Gel Extract on LDH Activities in Serum and Various Organs
- 4.4.** Effect of Various Doses of Aqueous *Aloe vera* Gel Extract on LPO Level in Various Organs
- 4.5.** Standardization of X-ray Dose
- 4.6.** Effect of Two Days and Four Days of X-ray Exposure on Body Weight, Diet Intake and Water Consumption
 - 4.6.1.** Histopathology of Liver
 - 4.6.2.** Histopathology of Spleen
 - 4.6.3.** Histopathology of Kidney
 - 4.6.4.** Histopathology of Testes
- 4.7.** Effect of X-ray/ or Aqueous *Aloe vera* gel Extract on Body Weight
 - 4.7.1.** Effect of X-ray/ or Aqueous *Aloe vera* Gel Extract on Diet Intake and Water Consumption
- 4.8.** Effect of X-ray/ or Aqueous *Aloe vera* Gel Extract on Histopathology of Liver, Spleen, Kidney and Testes
- 4.9.** Effect of X-ray and/ or Aqueous *Aloe vera* Gel Extract on LDH Activities in Serum and Various Organs
- 4.10.** Effect of X-ray and/ or Aqueous *Aloe vera* Gel Extract on Liver Function Test
- 4.11.** Effect of X-ray and/ or Aqueous *Aloe vera* Gel Extract on Renal Injury Markers
- 4.12.** Effect of X-ray and/ or Aqueous *Aloe vera* Gel Extract on Sperm Motility, Sperm Count and Testosterone Levels
- 4.13.** Effect of X-ray and/ or Aqueous *Aloe vera* Gel Extract on Micronuclei Formation in Spleen
- 4.14.** Effect of X-ray and/ or Aqueous *Aloe vera* Gel Extract on Chromosomal Aberration Assay in Liver
- 4.15.** Effect of Aqueous *Aloe vera* Gel Extract on Cell Death Caused by X-ray Irradiation
 - 4.15.1.** TUNEL assay
 - 4.15.2.** DNA fragmentation assay
- 4.16.** Effect of X-ray/ or Aqueous *Aloe vera* Gel Extract on Antioxidant Defense System in Plasma and Various Tissues
 - 4.16.1.** GSH
 - 4.16.2.** GR
 - 4.16.3.** GSH-Px
 - 4.16.4.** GST
 - 4.16.5.** CAT
 - 4.16.6.** SOD
- 4.17.** Effect of X-ray/ or Aqueous *Aloe vera* Gel Extract on ROS and LPO in Blood and Various Organs

| | | |
|----|--|----------------|
| | 4.18. Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Haematological Parameters | |
| | 4.18.1. Differential Leukocyte Counts (DLC) | |
| | 4.18.2. Red Blood Cell (RBC) | |
| | 4.18.3. Haemoglobin (Hb) | |
| | 4.18.4. Total Leucocyte Counts (TLC) | |
| | 4.18.5. Platelets | |
| | 4.18.6. Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Inflammatory Markers | |
| 5. | TABLES AND FIGURES | 153-202 |
| 6. | DISCUSSION | 203-242 |
| | 6.1. Phytochemical Analysis of Aqueous <i>Aloe vera</i> Gel Extract | |
| | 6.1.2. Components of Aqueous <i>Aloe vera</i> Gel Extract | |
| | 6.1.3. Analysis of Trace Elements in Aqueous <i>Aloe vera</i> Gel Extract | |
| | 6.1.4. Antioxidant Capacity of Aqueous <i>Aloe vera</i> Gel Extract | |
| | 6.2. Toxicity Profile of Aqueous <i>Aloe vera</i> Gel Extract | |
| | 6.2.1. To Standardize the Safe and Effective Dose of Aqueous <i>Aloe vera</i> Gel Extract in Various Organs Based on Histopathological and Biochemical alterations | |
| | 6.3. Histopathological Alterations | |
| | 6.3.1. Effect of Different Doses of Aqueous <i>Aloe vera</i> Gel Extract in Liver | |
| | 6.3.2. Effect of Different Doses of Aqueous <i>Aloe vera</i> Gel Extract in Spleen | |
| | 6.3.3. Effect of Different Doses of Aqueous <i>Aloe vera</i> Gel Extract in Kidney | |
| | 6.3.4. Effect of Different Doses of Aqueous <i>Aloe vera</i> Gel Extract in Testes | |
| | 6.4. Biochemical Alterations | |
| | 6.4.1. Effect of Various Doses of Aqueous <i>Aloe vera</i> Gel Extract on LDH activity in Serum and Different Organs | |
| | 6.4.2. Effect of Various Doses of Aqueous <i>Aloe vera</i> Gel Extract on LPO Level in Whole Blood and Different Organs | |
| | 6.5. Standardization of X-ray Doses for Whole Body Exposure | |
| | 6.5.1. Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Histopathology of Liver | |
| | 6.5.2. Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Liver Injury Markers | |

| | | |
|--------|---|----------------|
| 6.5.3. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extracton Chromosomal Aberration Analysis in Liver | |
| 6.6. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Histopathology of Spleen | |
| 6.6.1. | Modulatory Effect of <i>Aloe vera</i> Gel Extract on Clastogenic Damage Induced by X-ray in Spleen | |
| 6.7. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Histopathology of Kidney | |
| 6.7.1. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Renal Injury Markers | |
| 6.7.2. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on GFR of Kidney | |
| 6.8. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Histopathology of Testes | |
| 6.8.1. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Testicular Function Parameters | |
| 6.9. | Effect of Aqueous <i>Aloe vera</i> Gel Extract Against DNA Damage Caused by X-ray Irradiation in Various Organs | |
| 6.10. | Effect of X-ray and / or aqueous <i>Aloe vera</i> Gel Extract on LDH activity in serum and various organs | |
| 6.11. | Effect of X-ray and/ or aqueous <i>Aloe vera</i> Gel Extracton ROS Formation and LPO levels in Blood and Various Organs | |
| 6.12. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Antioxidant Defense System in Blood Plasma and Various Organs | |
| 6.13. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Inflammatory Markers in Serum | |
| 6.14. | Effect of X-ray and/ or Aqueous <i>Aloe vera</i> Gel Extract on Haematological Parameters | |
| 7. | SUMMARY AND CONCLUSION | 243-252 |
| 8. | BIBLIOGRAPHY | 253-344 |

PUBLICATIONS

ABSTRACT IN CONFERENCES