Cancer is probably one of the most widely researched areas as it has become the second lethal cause of death since 1960.

Cancer research is the intense scientific effort to understand disease processes and discover possible therapies, although understanding of cancer has greatly increased since the last decades of the 20th century. Cancer treatment is a task performed by physicians specialized in oncology, which is branch of medical science dealing with tumors.

Anti-neoplastic agent utilized now a days are generally palliative in their effects. There are large numbers of synthetic drugs, which are used as powerful anticancer drugs in conventional therapies, such as, Methotraxate, 5-Flourouracil, Cisplatin. Conventional therapies cause serious side effects and at best, merely extend the patient’s lifespan by a few years(1,2).

Over the last century natural products have been implicated in cancer prevention and that promote human health without recognizable side effects. Some of the prominent commercial plant-derived medicinal compounds include Vincristine (Leurocristine, Oncovin®), Vinblastine (Velban®), Vindesine (Fildesin®), Paclitaxel (Taxol®)(3-6). Commercially, these plant-derived medicines are worth about 14 billion US $ a year in the United States and 40 billion US $ world wide(7).

The literature indicates that many natural products are available as chemo preventive agents against commonly occurring cancers, occurring world wide. These natural products are found in vegetables, fruits, plant extracts and herbs(8).

Reddy(9) has shown list of chemo preventive natural products obtain form fruits and vegetables. Most studies appear to test the natural products on human leukemia cells.
Kessler(10) indicated that as many as 13 compounds found in the blood act synergistically to inhibit cancer cell growth in vitro and in animals.

Some of the Anticancer natural drugs which I have used in my research are curcumin obtained form curcuma longa L. turmeric(11), Aloe-Emodin [extracted form Aloe-Vera leaves(12)], Beta carotene [extracted form carrot(13)] and Indole-3-carbinol [Extracted form cabbage, broccoli(14)].

Reddy et al(9) demonstrated a mechanism by which Antioxidant can also improve the efficacy of a chemotherapeutic agents.

Ala and Volate(15) have summarized some of the possible mechanisms of action through which herbs inhibit cancer with particular emphasis on modulation of inflammation and cell signaling pathways.

FDA Database(16) consequently reports dietary supplements used as anticancer natural drugs. The DSHEA (Dietary supplement health and educational act of 1994) acknowledged the existence of positive relationship between sound dietary practice and good health which catalyzed a massive production of dietary supplements with various health benefit claims.

The term cancer chemoprevention was first introduced by Michael Sporn in 1976. It was defined as the utilization of chemically active compounds to “reverse, suppressor prevent progression of disease form pre-invasive cancer to malignancy”(17).

Curcumin, a yellow spice and pigment form curcuma longa L. (Zingiberaceae), is by for known for its antioxidant, anti-inflammatory, anticancer, antibacterial and antiamoebic activities(18-20).

Curcumin has been isolated in the 19th century; extracts of the rhizomes of C. longa have been in use form the vedic ages(11).
Mazumdar(21) reported inhibition of human immuno deficiency virus (HIV) type -1 integrase by curcumin. Curcumin as an inhibitor of tumor formation and promotion induced by benzapyren, 7, 12-dimethyl benza anthracene was demonstrated by Ikezaki(22).

Woo(23) suggested that the induction of Caki (human kidney carcinoma cells) programmed call death activated by Akt dephosphorylation Itrosamine.

Fiorucci(24) published that curcumin inhibits cyclo-oxygenase2 (cox-2) as well as lipoxygenase (lox), two enzymes involved in inflammation.

Chattopadhyaya(25) showed biological action and medicinal applications of Turmeric and curcumin.

Indole-3-carbinol (I3C) a naturally occurring plant alkaloid present in significant concentrations in Brussels sprout and other cruciferous vegetables(14). Bradlow(26) shows that Indole-3-carbinol affects estrogen metabolism in many ways that might help prevent breast cancer and may also be critical in preventing or retarding prostate cancer.

Wattenberg(27) was the first scientist to show that Indole-3- Carbinol inhibits mammary tumor formation induced by 7, 12 dimethylbenza[a]anthracene (DMBA) in female Sprague- Dawley (SD), rats and neoplasia of the fore stomach of female ICR/ H a mice induced by benaza a pyrene (BaP).

Due to the diverse etiology of human cancer the ability to protect against many classes of carcinogens is a valuable property of a chemopreventive agent. The chemopreventive activity of I3C has been reported in liver, forestomach, lung and mammary gland(28,29).

Henriects(30) and Babich(31) have shown that through I3C touted as a chemopreventive agent for breast cancer but it can act both as an inhibitor and promoter of carcinogenesis.
Gary(29) has studied the anticarcinogenesis activity of I3C in the development of multiorgan rat model with carcinogenesis and has shown that I3C in acid condensation products can be converted to mutagenic nitrosamines by treatment with acid and nitrile under stomach condition, suggesting possible genotoxic or promotional mechanism in vivo. In mouse epidermis, I3C acts as a promoter by enhancing TPAC 12-O-tetra decanoyl –phorbol-13-acetate) induction of ornithine decarboxylase. Conversely, when it was given with TPA after a subcarcinogenic dose of DMBA in the two-stage mouse skin model, I3C significantly inhibited tumor development.

Aloe –Emodin(AE) is a hydroxyl anthraquinone naturally present in the leaves of some species of aloes that has shown anticancer activity(12).

Grindlay(32) reported that AE was endowed with some degree of cytotoxicity for erythroleukemia cell lines but only at high concentrations. On the other hand Schmidt(33) demonstrated a stimulatory effect of AE on Urokinase secretion and colorectal carcinoma cell growth.

Pecere(34) has shown that AE is selectively toxic against neurectodermal tumors and inhibits human neurectodermal tumor growth in an animal model with no evidence of acute or chronic toxicity and also describes the discovery of AE as a new type of anticancer agent possessing an unprecedented cytotoxic mechanism.

Fenig(35) reported the combined effect of aloe-emodin and some chemotherapeutic agents on the proliferation of an adherent variant cell line of Merkel cell carcinoma, an aggressive carcinoma of the skin. MCC cells are both chemo sensitive and radiosensitive.

Chemoprevention plays a pivotal role in the war against cancer. Preclinical and clinical studies have strongly supported the hypothesis that chemoprevention reduces the incidence and mortality rates for a variety of chronic disorders
including cancer. Ames(36) and Wargevich(37) reported that the common fruits and vegetables contain bioactive compounds with antioxidant activities that may potentially be chemo protective against a variety of cancers.

A pertubing example is the antioxidant used in chemoprevention of lung cancer by carotenoids and vitamin E based on the hypothesis that high intake of fruits and vegetables was associated with reduced risk of lung cancer study by Mchaughlin(13).

Electrochemical studies on anticancer drugs have been reported in some reviews of drugs and chemical substances having biological significance (38-40).

A brief summary of electrochemical studies of drugs relevant to the present study is given in the following paragraphs:

The quinone containing antitumor antibiotics mitomycin-B and mitomycin-C were studied using DC polarography and cyclic voltametry by Rao and others(41, 42).

Den Harlig(43) obtained DC polarographic curves for mitomycin-C at pH<3 and pH>12. Beijine(44) studied mitomycin-C in human blood plasma and urine.

A wide range of extracted and synthesized drug molecules have electron transfer capabilities, which allow them to generate reactive oxygen species or to be considered as bioreductive alkylating agents.

There are several main classes of electron transfer agents, some of them are nitroaromatics(45-49), quinones(50) or phenolic precursors(51,52): aza compounds iminium ions(53,54) heterocyclic salts(55) and metal complexes(56) or metal quelators.

Nitroaromatic compounds, ArNO₂ are a very important class of compounds which have been used extensively in the treatment of anaerobic infections and
under investigation regarding their use in cancer therapy acting as specific cytotoxic and markers for hypoxic regions in tumors.

Palmar(57) studied the cyclic voltammetry and polarography of nitroaromatics, may involve the addition up to 4 electrons. In the absence of oxygen or under hypoxic conditions, the nitro radical anion is further reduced to the nitro (2e⁻), hydroxylamine (4e⁻) and amine (6e⁻)(58).

With an invention to look at long time cytotoxicity of drugs, mainly nitroaromatic derivatives, electrochemical a methodology has been considered a useful quantitative tool to study the in situ reactivities of electrogenerated intermediates towards endobiotics(59). Some drugs like Nifedipine(60), Nitrendipine(61) and Flutamide(62) show electrochemical activity in acidic and basic media.

Gutierrez(63) has shown that electrochemical techniques could be used to clarify drug's mechanism of action.

Covalent modifications of DNA by antineoplastic agents represent a potent biochemical lesion, which can play a major role in drug mechanism of action. There are considerable enthusiasm over development of electrochemical biosensors for DNA hybridization.

Palecek(64) studied the anodic polarographic current given by Flouroracil.

While Yan(65) carried out the determination of 5-Flourouracil in blood serum using differential pulse cathodic stripping voltammetry (DPCSV) following sample pretreatment with trichloroacetic acid.

There are numerous applicability in the field of cancer research of amperometric method of analysis generally used for the determination of metal ions and organic compounds(66).
Agarwal(67) determined arsenic with 2-mercapto and 3-mercaptopropanoic acid ampero-metrically. Recently amperometric studies of complexes of Dysprosium (III) with Rhodamin B, has been reported by Rathore(68).

Various other methods have also been reported in the literature for the estimation of anticancer drugs in their pharmaceutical formulations and also in different forms(69).

Study on Mn(II), Co(II), Ni(II) and Zn(II) complexes of substituted aryl furyl and β- diketones have been reported by Deolankar and Deshpande(70).

Curcuminoids as potential of new iron chelating agents analysed by spectroscopic, polarographic and potentiometric study on their Fe(III) complexing ability(71).

Khosro(72) has reported the synthesis and characterization of dual function vanadyl, gallium and indium curcumin complexes for medicinal applications.

Transition metal complexes with various organic ligands have been studied on a DME by a number of workers(73-75).

Complex formation of Co(II), Ni(II) and Zn(II) with some sulphonamides derived form amino acids have been reported by Mukherjee and Dhar(76).

The capacity of incompleted- subshell of the transition metals has introduced millions of compounds in the literature. Many new complexes have been prepared and characterized in the world of science. As a result of this fact a number of research journals namely devoted to the subject are published regularly. Recently the subject has been beautifully reviewed in metal-ligand interaction: structure and reactivity(77).

Amperometric determination of Fe(II) and Co(II) binary complexes with Oxytetracycline and Neomycin have been reported(78).

Amperometric biosensors for clinical and therapeutic drug monitoring study have been reported by Josephiwang(79). Amperometric studied on Tylosin
and Levorin (antibiotics) in aqueous mixture of organic solvents have appeared in the literature(80,81).

Many scientists (82-83) have studied the structural relationship in which the molecular formulae of drugs are directly related to their biological activity (84-86).

Use of metal complexes in cancer chemotherapy compounds have been identified as highly cytotoxic and tumor reducing(87). Cisplatin was found to be the most active compound in this category and capable of cross linkage with DNA(88). Cisplatin is useful in carcinoma of head and neck(89). Though metals constitute about 3% of human body weight, but the intricate biological system depends very much up on the metals. The requirement for a particular metal ion must be related to its chemical structure and possibly redox properties can be tuned finally by the biological ligands.

Most of the drugs are organic compounds and they have a great tendency to form complexes with these metal ions.

In the recent past electrochemical methods have been widely used for the study of stoichiometry and formation constants of binary and ternary metal complexes.

Mishra(90) reported antibacterial study of 3d-metal complexes with thiophene 2-aldehyde-4chloro/bromoaniline. Microbial studies on complexes of heavy metals (Particularly those belonging to the transition series) have also been studied by some scientists(91).

A number of metal ions are essential for life process; some are present in the structural units of our body while others are used in metabolic activities in the form of enzymes. The chemistry of life involves in an essential way, some chemical elements including metals(92,93).

Riboflavin(94), Folic acid(95), Thioquinone(96), Adenine a carcinogenic compounds, amino and hapthol(97) have been reported and chelating properties have been discussed in the light of their anticancer activities.
References:


63. Gutierrez PL, Nguyen B, In : Electrochemistry in Cancer : Application to pharmacological studies of Quinone-Containing Antitumor agents. In :

64. Palecek E, Jelen F, Mac Ank H, Lasovsky, *Bioelectrochem Bioenerg*; 1981, 8(6), 621.


86. Horvath WW, Beaton GR, Henry MC, *Nutrition*: 1, 324.