PREFACE

Among the important applications of organic compounds in industry, are their uses as agrochemicals, mostly pesticides, and drug chemicals. In view of the significant role which pesticides and drugs play in the context of environment/human health, there is a dire need of simple, rapid and cost-effective methods for assuring the quality of their marketed products and also checking the entry of adulterated/spurious/sub-standard materials into the market. The methods have to be such that they can also be easily adapted to determine their presence in various substrates/residues. This aspect is particularly important in case of pesticides which happen to be toxic and consequently pollute the environment/human health. The work presented in this thesis is an endeavour in this direction.

Among organic sulphur compounds, thiourea derivatives and organo-isothiocyanates have attained special importance as synthetic organic compounds of considerable industrial importance. Whereas the former find applications as pesticides and drug, the latter find use as insecticides. Thiophanate-methyl and thiophanate (thiourea derivatives); and ditrapex (isothiocyanate derivative) are widely used as agricultural fungicides and insecticides respectively. Thiouracil, methyl thiouracil and thiopentone sodium, on the other hand, are commercial drugs based on thioureas. Amines are important constituents of pharmaceutical preparations. Dopamine hydrochloride is an important antihypertensive drug based on an amine. Among the phosphorus organic compounds, derivatives of thiophosphoric and dithiophosphoric acids have attained special importance in agriculture as insecticides. Oxydemton-methyl, malathion, formothion and dimethoate are commercial insecticides formulated from above acids.

Since the above industrial products (pesticides as well as drugs) are derived from organic compounds; obviously their formulations contain these very compounds as active ingredients. The toxic residues which the pesticides leave in environment or food commodities after they are applied to the crops, are in fact the residues of these very organic compounds in them. Hence, monitoring the environment/ foods for pesticide residues infact means the identification and determination of these very organic compounds in them. The same is also true with regard to the analysis of formulations for their quality control. Based on the reaction characteristics of the organic moiety present in the formulations/residues, the methods for the analysis of above drugs as well as pesticides have been developed.
The observations that thiourea function reacts at DME in polarography to yield a well-defined analytically useful anodic wave, and reacts with nickel to form coloured complex absorbing at 360nm, have been made the basis of polarographic and spectrophotometric methods for the determination of thioureas and commercial products based on them. The methods have subsequently been extended to the analysis of some organoisothiocyanates and amines based on their mutual reaction to form thiourea derivatives. Since amines and isothiocyanates are also the active ingredients of some drug and pesticide formulations, the methods have subsequently been extended to the analysis of dopamine (an amine-based drug) and ditrapex (an isothiocyanate-based insecticide.)

Organophosphorous insecticides on alkaline hydrolysis yield quantitatively alkali salts of mono/dithiophosphoric acid. Prompted by the observation that the latter (i) react with cerium(IV) which oxidises them in dilute sulphuric acid medium to bis (dimethoxy phosphonato) disulphide, (ii) react with copper(II) to form coloured complexes absorbing in the uv/visible region, and (iii) react at DME in polarography to give well-defined anodic waves, we have succeeded in evolving titrimetric (oxidimetric), spectrophotometric and polarographic methods for the determination of above insecticide both in their formulated products as well as residues.

For the sake of convenience, research work is presented in these chapters. Chapter I deals with the general introduction, emphasizing the importance of sulphur, nitrogen and phosphorus organic compounds in industry and agriculture, and giving salient features of polarographic and spectrophotometric techniques used in the present work. This chapter also includes general experimental i.e. preparation/source of compounds, preparation of reagent solutions and apparatus used. Chapter II is divided into two sections “A” and “B”. Section “A” is devoted to the analysis of thiourea derivatives and commercial products based on them i.e. thiophanate-methyl (a fungicide), methyl thiouracil and thiopentone sodium (drugs). The determination of thiophanate-methyl in residues on foodstuffs is also included in this section. The determination of amines and isothiocyanates (based on their transformation into thiourea derivatives) as such, in drug/insecticide formulations and ditrapex insecticide residues in foodstuffs is the subject matter of Section “B”. In Chapter III is presented the work on the analysis of some organophosphorus insecticides viz. oxydemton-methyl, malathion, formothion and dimethoate in their formulations and residues (on foodstuffs). Chapter II-A, II-B and III are further divided into following subheads: (i) introduction, (ii) present work, (iii) experimental procedures, (iv) results, (v) discussion, (vi) summary and (vii) references.