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Nucleic Acids and Their Derivatives

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I. INTRODUCTION: HISTORICAL OVERVIEW

Numerous studies have reviewed the technical background of thin-layer chromatography (TLC; planar or flatbed) (1), which developed under the guidance of Ismailow and Schraiber in 1938 and may date back to Friedlieb Ferdinand Runge (1850). The complexities of the early systems were refined by Stahl (1958–1960), and these breakthroughs began an immense contribution to the understanding of nucleic acid chemistry (2). The early papers of Ismailow, Schraiber, and Stahl were translated and reproduced by Pelick et al. (3).

Simultaneous with these discoveries, paper chromatography (PC) began with major discoveries in solvents and new types of paper by Consden, Martin, and Gorden (1946). The importance attached to paper chromatography resulted in the Nobel prize for Martin and Synge. Brief and compelling historical overviews of TLC and PC are given by Petrowitz (4) and Scheit (5).

One of the most important chromatographic systems for nucleic acids, ion-exchange chromatography, received great impetus with the development of polyethyleneimine-HCl prepared cellulose (PEI), which became available by 1961 (5,6). The studies that followed laid the foundation for analytical and preparative TLC of nucleic acids. Many plates are available for TLC, but most reports are limited to the use of PEI-cellulose, octyldecasilene (ODS), and silica gel in simple unidimensional systems, typically for prescreening prior to preparative chromatography.

The systems developed for gel electrophoresis have diminished the need for TLC of large oligonucleotides. Additionally, the inability to have stable thick ($\geq$2 mm) chromatographic plates has diminished the need for preparative TLC. High-performance liquid chromatography (HPLC) is important for smaller oligomer separations and is especially important for preparative chromatography. TLC and HPLC can serve for initial chemical characterization. Mass spectroscopy coupled with UV and Fourier transform infrared (FTIR) spectroscopy have added to chemical characterizations in chromatography. These systems are now available in TLC. HPLC, however, is limited when highly radioactive molecules are used that require extensive cleaning of the whole HPLC system. Additionally, TLC offers flexibility in the hands of experimentalists that matches that of HPLC, with less labor and cost (1,7–9).

II. CHEMICALS AND PLATES

A. Mobile-Phase Selection of Solvents

Siouffi and coworkers (10,11) discussed specific strategy selections of solvents through the PRISMA approach. Tactically, an initial screen of unknowns or products on TLC is preparatory