6 Summary

The research engaged in potential utilization of non-silica-based stationary phases has proceeded many years. The attention has been focused among other on metal oxide-based stationary phases, which appear to be an appropriate alternative to SiO_2. These sorbents differ from SiO_2 in retention and selectivity. Differences, which are caused by different chemical properties of metal oxides, can influence the separation process. More types of interactions (reversed-phase interaction, ion-exchange and ligand exchange) simultaneously contribute to the retention of an analyte on stationary phases based on metal oxides. How much is the retention of a defined substance affected by each type of interaction depends on conditions of analysis (the buffer type, pH, buffer concentration and type of organic modifier used). The effectiveness of metal oxide-based columns is much higher than effectiveness of polymer-based stationary phases, and in recent time it is fully comparable with silica-based columns. Additionally these phases dispose of higher thermal and chemical stability in comparison to SiO_2-based reversed phases.

Theoretical introduction of this dissertation thesis is concerned with general properties and possibilities of HPLC applications in pharmaceutical analysis and with stationary phases used in the current analytical practice. Attention is paid to widely used SiO_2-based phases, followed by hybrid phases, polymeric phases and graphitized carbon-based phases. The main part of the theoretical introduction is focused on metal oxide-based stationary phases, especially ZrO_2-based ones.

The results of experimental work are contained in the text of original publications in impacted journals.

The summary of results achieved, corresponding to published studies:

- The method for monitoring potential degradation process of ibuprofen and parabens in topical pharmaceutical preparation was developed and validated. Different selectivity of ZrO_2-based stationary phases (compared to SiO_2-based phases) enabled to achieve sufficient resolution of all analysed compounds. The method, utilizing Zr-Carbon C18 column for resolution of ibuprofen and its two degradation products, and simultaneously methylparaben, propylparaben and their degradation

product, proves a practical example of potential utilization of ZrO_2-based stationary phase in routine drug analysis.

- The retention behaviour of ondansetron and its five pharmacopoeial impurities on different stationary phases based on SiO_2 and metal oxides was studied. Different properties of ZrO_2-based and TiO_2-based stationary phases compared to SiO_2-based sorbents enabled to achieve better separations of analysed substances. The developed and validated method for evaluation of ondansetron, utilizing Zr-PBD column for separation, confirms the potential of applicability of reversed ZrO_2-based stationary phase in pharmaceutical practice.

- The retention behaviour of ondansetron and its five impurities on TiO_2-PE stationary phase was mapped. The separation conditions were optimized and validity of the method verified. Afterwards different retention parameters of separation of analysed compounds on TiO_2-PE and Zr-PBD columns were compared. Attention was also focused on comparing of thermodynamic behaviour of analysed substances on both columns. The applicability of TiO_2-PE column as an alternative to Zr-PBD column for routine pharmaceutical evaluation of ondansetron has been proved.

- The HPLC method coupled with coulometric detection for the assay of biotin in multivitamin preparations has been developed and validated. The selectivity and high sensitivity of coulometric detector, which enabled quantification of minor component in complex matrices with considerably differing concentrations of active constituents, was utilized during the method development. The possibility and convenience of HPLC coupled with coulometric detection as an alternative for electrochemically active compounds in the field of practical pharmaceutical analysis was proved.