# ไมโครอิมัลชันอิเล็กโทรไคเนทิกโครมาโทกราฟีสำหรับการแยกและการวิเคราะห์อะเวอร์เมกทินแมกโครไซคลิกแลกโทน


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# MICROEMULSION ELECTROKINETIC CHROMATOGRAPHY FOR SEPARATION AND ANALYSIS OF AVERMECTIN MACROCYCLIC LACTONES

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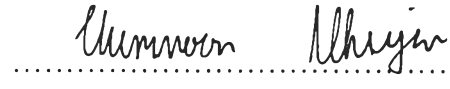

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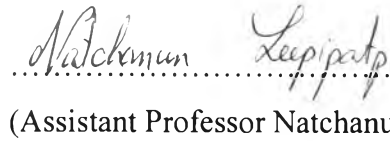

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ปริญญา สีลานันท์: ไมโครอิมัลชันอิเล็กโทรไคเนทิกโครมาโทกราฟีสำหรับการแยกและการวิเคราะห์อะเวอร์เมกทินแมกโครไซคลิกแลกโทน (MICROEMULSION ELECTROKINETIC CHROMATOGRAPHY FOR SEPARATION AND ANALYSIS OF AVERMECTIN MACROCYCLIC LACTONES) อาจารย์ที่ปรึกษา: ผู้ช่วยศาสตราจารย์ ดร. ธรรมนูญ หนูจักร 70 หน้า. ISBN 974-53-2663-1

ได้พัฒนาเทคนิคไมโครอิมัลชันอิเล็กโทรไคเนทิกโครมาโทกราฟี (MEEKC) สำหรับการแยกและการวิเคราะห์อะเวอร์เมกทินแมกโครไซคลิกแลกโทน ได้แก่ อะบาเมกทิน โดราเมกทิน และไอเวอร์เมกทิน โดยใช้ไมโครอิมัลชันบัฟเฟอร์ที่ประกอบด้วย 50 mM ฟอสเฟตบัฟเฟอร์ที่ pH 2.5, 1.1 % v/v *n*-ออกเทนเป็นหยดน้ำมัน, 180 mM โซเดียมโดเดกซิลซัลเฟตเป็นสารลดแรงตึงผิว, 890 mM 1-บิวทานอลเป็นสารลดแรงตึงผิวร่วม และ 30 % v/v เอทานอลเป็นตัวทำละลายอินทรีย์ร่วม ศักย์ไฟฟ้าที่ใช้ -15 kV และอุณหภูมิที่ใช้แยก 25°C พบว่าได้ค่าการแยกของพีกที่ฐานของสารมากถึง 4.9 ด้วยเวลาวิเคราะห์ภายใน 25 นาที มีความแม่นและความเที่ยงของวิธีการสูง ได้ใช้วิธี MEEKC ที่พัฒนาขึ้นสำหรับปริมาณวิเคราะห์ของอะเวอร์เมกทินในสูตรผสมทางการค้า พบว่าปริมาณของอะเวอร์เมกทินที่วิเคราะห์ได้จาก MEEKC ในแต่ละสูตรผสมไม่แตกต่างอย่างมีนัยสำคัญกับที่วิเคราะห์ได้จากไฮเพอร์ฟอร์มานซ์ลิควิดโครมาโทกราฟี ดังนั้น MEEKC สามารถใช้เป็นอีกวิธีทางเลือกหนึ่งสำหรับปริมาณวิเคราะห์ของอะเวอร์เมกทิน ด้วยเวลาวิเคราะห์ที่เร็วกว่าและปริมาณตัวทำละลายอินทร์ย์ที่ใช้น้อยกว่า

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PARINYA SEELANAN: MICROEMULSION ELECTROKINETIC CHROMATOGRAPHY FOR SEPARATION AND ANALYSIS OF AVERMECTIN MACROCYCLIC LACTONES. THESIS ADVISOR: ASST. PROF. THUMNOON NHUJAK, Ph.D., 70 pp. ISBN 974-53-2663-1.

Microemulsion electrokinetic chromatography (MEEKC) was developed for quantitative analysis of avermectins, such as abamectin, doramectin and ivermectin, in commercial formulations, using the microemulsion buffer containing a 50 mM phosphate buffer at pH 2.5, 1.1 % v/v *n*-octane as oil droplets, 180 mM sodium dodecyl sulfate as surfactant, 890 mM 1-butanol as co-surfactant and 30 % v/v ethanol as organic co-solvent; applied voltage of -15 kV; and separation temperature at 25 °C. Achieved baseline resolution up to 4.9 was obtained with analysis time within 25 min. High accuracy and precision of the method were obtained. The developed MEEKC method was used for quantitative analysis of avermectins in commercial formulations. The contents of avermectins in commercial formulations determined by MEEKC were found to be insignificantly different with those determined by high performance liquid chromatography (HPLC). Therefore, MEEKC can be used as an alternative method to HPLC for quantitative determination of avermectins with shorter analysis time and lower amount of organic solvent consumption.

Department.....Chemistry..... Student's signature.....
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# LIST OF ABBREVIATIONS AND SYMBOLS

| | |
|---|---|
| A | abamectin $B_1$ |
| BGE | background electrolyte |
| D | doramectin |
| I | ivermectin |
| CE | capillary electrophoresis |
| CEC | capillary electrochromatography |
| CGE | capillary gel electrophoresis |
| CIEF | capillary isoelectric focusing |
| CITP | capillary isotachophoresis |
| CMC | critical micelle concentration |
| CZE | capillary zone electrophoresis |
| DB | dodecyl benzene |
| EOF | electroosmotic flow |
| HPLC | high performance liquid chromatography |
| I.D. | internal diameter |
| ISTD | internal standard |
| LC | liquid chromatography |
| MEKC | micellar electrokinetic chromatography |
| MEEKC | microemulsion electrokinetic chromatography |
| MS | mass spectrometry |
| RSD | relative standard deviation |
| SDS | sodium dodecyl sulphate |
| $A$ | peak area |
| $A_{aq}$ | analyte molecule in the aqueous phase |
| $A_{mc}$ | analyte molecule in the microemulsion phase |
| $A_{corr}$ | corrected peak area |
| $B$ | constant value (2400 K) |
| $c$ | concentration of analyte |
| $D$ | diffusion coefficient |
| $D_{aq}$ | diffusion coefficient of the solute in the aqueous phase |
| $D_{mc}$ | diffusion coefficient of the solute in micelle (microemulsion) phase |

| | |
|---|---|
| $D_{th}$ | diffusion coefficient of the solute by thermal dispersion |
| $E$ | electric field strength |
| $e$ | electronic charge |
| $F$ | Faraday's constant |
| $H$ | plate height |
| $H_{aq}$ | plate height due to intermicelle mass transfer in the aqueous phase |
| $H_l$ | plate height due to longitudinal diffusion |
| $H_{mc}$ | plate height due to sorption-desorption kinetics in microemulsion solubilisation |
| $H_{pd}$ | plate height due to micellar polydispersity |
| $H_t$ | plate height due to thermal dispersion |
| $I$ | ionic strength |
| $I_A$ | electric current |
| $K$ | distribution constant |
| $k$ | retention factor |
| $k_A$ | retention factor of analyte A |
| $k_B$ | retention factor of analyte B |
| $k_C$ | retention factor of analyte C |
| $k_d$ | desorption rate constants |
| $k_s$ | sorption rate constants |
| $k^*$ | boltzmann constant |
| $L$ | total capillary length |
| $l$ | the length of capillary to detector |
| $l_{inj}$ | length of analyte injected |
| $N$ | the number of theoretical plate, or peak efficiency |
| $n_{aq}$ | the amount of analyte in aqueous phase |
| $n_{mc}$ | the amount of analyte in microemulsion phase |
| $\Delta P$ | pressure difference across the capillary |
| $Q$ | amount of analyte |
| $Q_{inj}$ | quantity of sample injected |
| $Q_{determined}$ | the determined amount of analyte in the diluted sample after spiking standard |
| $Q_{sample}$ | the determined amount of analyte in the diluted sample solution before spiking standard |

| | |
|---|---|
| $Q_{spiked}$ | the amount of spiked standard |
| $R$ | gas constant |
| $R_s$ | resolution |
| $r$ | internal capillary radius |
| $r_h$ | hydrodynamic radius |
| $T$ | absolute temperature |
| $t$ | time |
| $t_0$ | retention time of unretained compound |
| $t_{eo}$ | migration of EOF |
| $t_{inj}$ | injection time |
| $t_m$ | migration time |
| $t_{mc}$ | retention time of microemulsion |
| $t_R$ | retention time |
| $t_{R,A}$ | retention time of analyte A |
| $t_{R,B}$ | retention time of analyte B |
| $t_{R,C}$ | retention time of analyte C |
| $t^*_{mc}$ | mean life-time of analyte in microemulsion (micelle) |
| $V$ | applied voltage |
| $V_F$ | volume flow of the analyte passing the detector |
| $V_{inj}$ | volume of sample injected |
| $v_{eo}$ | electroosmotic velocity |
| $v_{ep}$ | electrophoretic velocity |
| $v_{net}$ | total electrophoretic velocity |
| $w$ | the amount of sampling weight |
| $w_b$ | peak width at base |
| $w_h$ | peak width at half height |
| $x_{aq}$ | mole fraction of analyte in aqueous phase |
| $x_{mc}$ | mole fraction of analyte in microemulsion phase |
| $z$ | charge of an ion |
| $\alpha$ | selectivity |
| $\varepsilon$ | permittivity |
| $\phi$ | volume of the aqueous phase to microemulsion phase |
| $\eta$ | viscosity |

| | |
|---|---|
| $\kappa$ | electrical conductivity |
| $\lambda_s$ | thermal conductivity |
| $\mu$ | electrophoretic mobility |
| $\mu_{eo}$ | electroosmotic mobility |
| $\mu_{obs}$ | observed mobility |
| $\mu_{mc}$ | mobility of microemulsion |
| $\mu_{net}$ | total mobility |
| $\mu^o$ | absolute mobility at zero ionic strength |
| $\sigma$ | standard deviation of peak in distance unit |
| $\sigma_{\mu,mc}$ | standard deviation of electrophoretic mobility of microemulsion (micelle) |
| $\sigma^2$ | peak variance |
| $\sigma^2_{diff}$ | peak variance due to longitudinal diffusion |
| $\sigma^2_{th}$ | peak variance due to thermal diffusion |
| $\tau$ | standard deviation of peak in time unit |
| $\zeta$ | zeta potential |