Analytical GC-FID method for the determination of organic solvents in radiopharmaceutical

ABSTRACT

Background: Organic solvents play an indispensable role in most of the radiopharmaceutical production stages. It is almost impossible to remove them entirely in the final formulation of the product. Objective: In this presented work, an analytical method by gas chromatography coupled with flame ionization detection (GC-FID) has been developed to determine organic solvents in radiopharmaceutical samples. The effect of injection holding time, temperature variation in the injection port, and the column temperature on the analysis time and resolution ($R \geq 1.5$) of ethanol and acetonitrile was studied extensively. Methods: The experimental conditions were optimized with the aid of further statistical analysis; thence, the proposed method was validated following the International Council for Harmonisation (ICH) Q2 (R1) guideline. Results: The proposed analytical method surpassed the acceptance criteria including the linearity > 0.990 (correlation coefficient of R2), precision < 2%, LOD, and LOQ, accuracy > 90% for all solvents. The separation between ethanol and acetonitrile was acceptable with a resolution $R > 1.5$. Further statistical analysis of Oneway ANOVA revealed that the increment in injection holding time and variation of temperature at the injection port did not significantly affect the analysis time. Nevertheless, the variation in injection port temperature substantially influenced the resolution of ethanol and acetonitrile peaks ($p < 0.05$). Conclusion: The proposed analytical method has been successfully implemented to determine the organic solvent in the [18F]fluoro-ethyl-tyrosine ([18F]FET), [18F]fluoromisonidazole ([18F]FMISO), and [18F]fluorothymidine ([18F]FLT).

Keyword: Organic solvent; Organic solvent analysis; Quality control; Gas chromatography; Flame ionization detection; DB-200; Radiopharmaceuticals