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Design and optimization of a luminescent samarium complex of isoprenaline: a chemometric approach based on factorial design and Box-Behnken response surface methodology

Marwa Sakr[1], Rasha Hanafi[2], Marwa Fouad[3], Hala Al Easa[1] and **Samir El Moghazy[3]**
[1]Qatar University, Qatar, [2]University in Cairo, 11835, Egypt, [3]Cairo University, 11562, Egypt

A chemometrically optimized procedure has been developed for the determination of isoprenaline (ISO) in the parent substance as well as in its respective pharmaceutical preparation. Although spectroscopic determination of isoprenaline metal complexes has been described in literature, yet, no methods for the quantification of isoprenaline with samarium or any other lanthanide metal have been reported. Fractional factorial design (FFD) was implemented in the initial screening procedure of the four designated factors, namely, reaction time (RT), metal volume (MV), pH and temperature (T) followed by response surface methodology (RSM) optimization tool aided by Box-Behnken design (BBD). The proposed techniques are based on a multivariate approach where a complexation reaction between isoprenaline (ISO) and samarium III (Sm^{3+}) metal was exploited for the first time to synthesize novel fluorescence and absorbance probes of ISOSm. Maximum fluorescence intensity (Y1) as well as maximum absorbance (Y2) of the produced complex were attained at $\lambda_{ex/\lambda em}$= 315/450 and λ 295 nm for spectrofluorimetric and spectrophotometric determinations, respectively, against blank solutions. Using assessment quality tools such as, Pareto charts, normal probability plots and ANOVA, significant factors were successfully indicated (p=0.05). Furthermore, the proposed methods verified specificity and accuracy for the determination of isoprenaline in its pure and pharmaceutical preparation using spectrofluorimetric (A) and spectrophotometric (B) techniques. Linearity was obtained in the range of (0.02-0.50 µg/mL) and (2-12 µg/mL) upon employing both techniques A and B, respectively. Limit of detection (LOD) and limit of quantification (LOQ) were found to be $5.1877x10^{-3}$ µg/mL, 0.01572 µg/mL and 0.5593 µg/mL, 1.6949 µg/mL, upon employing techniques A and B, respectively. Standard addition method was applied for both techniques. The analysis was successfully applied to the assay of pure powder and pharmaceutical dosage forms after which the corresponding mean recoveries were computed and were found to be in the range of 99.546%-100.257% (technique A) and 99.872%-99.887% (technique B) with RSD (<1).

rasha.hanafi@guc.edu.ng

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