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Research Article

DIALYSIS AS AN EFFICIENT METHOD FOR REMOVAL OF RESIDUAL FORMALDEHYDE

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ABSTRACT

A reasonable number of reactions employ formaldehyde and a very good example of such a reaction is the preparation of drug-DNA adducts (DDA). Though some methods have been reported for removal of formaldehyde from aqueous solutions, they present a complex procedure. In the present study we evaluated the process of simple dialysis using membrane for the removal of residual formaldehyde. Hantzsch reaction was employed for the quantification of formaldehyde during the studies. The dialysis method was found to be an efficient method for removal of residual formaldehyde from aqueous solutions. It is anticipated that the method would prove to be very useful in removal of unreacted formaldehyde from aqueous reaction mixtures. The method is expected to be an important step in the purification of drug-DNA adducts.

KEYWORDS: Formaldehyde; dialysis tube; drug-DNA adduct; Hantzsch reaction

INTRODUCTION

A reasonable number of reactions employ formaldehyde as a reactant and removal of residual formaldehyde from the product is a pre-requisite for the success of the method. A very good example of such a reaction is the preparation of drug-DNA adducts (DDA).[1-3] Though some methods have been reported for removal of formaldehyde from aqueous solutions, they present a complex procedure.[4] In the present study we evaluated the process of simple dialysis using membrane for the removal of residual formaldehyde

MATERIALS AND METHODS

Materials

Paraformaldehyde was purchased from Spectrum reagents and Chemicals Pvt. Ltd, Kochi, India. Dialysis tube with molecular cut of value of 12,000 D was purchased from Sigma-Aldrich Co., MO, USA. All other reagents were of analytical-reagent grade. Reagent grade I water (Millipore, Molsheim, France) was used for the study.

Validation of the proposed method for removal of residual formaldehyde

200 µL of aqueous formaldehyde solution (0.37 %v/v) prepared from paraformaldehyde was dialyzed for 24 h in dialysis tube with 20 mL water as receptor phase. Contents inside (donor compartment) and outside the dialysis membrane (receptor compartment) were tested for formaldehyde content using the Hantzsch method.

Calibration curve for formaldehyde was prepared based on a reported Hantzsch reaction method between acetyl acetone, ammonium acetate and formaldehyde.[5] Acetyl acetone-ammonium acetate reagent was prepared by mixing 0.02 M acetyl acetone with 2 M ammonium acetate at pH 6. The reagent was mixed with equal volume of aqueous formaldehyde solution (0.05-0.6 µg/mL) and incubated for 1 h at 37ºC and measured spectrofluorimetrically at an excitation wavelength of 410 nm and an emission wavelength of 510 nm.

RESULTS AND DISCUSSION

Validation of the proposed method for removal of residual formaldehyde

We planned dialysis of the sample against water. We presumed that residual formaldehyde will be dialyzed out resulting in formaldehyde free sample. To justify this hypothesis, we planned a validation study of the proposed method. Towards this objective, we employed a well-established Hantzsch reaction for the quantification of formaldehyde. Hantzsch reaction is based on formation of a greenish yellow fluorescence in the presence of formaldehyde and is useful for detection (detection limit) of formaldehyde in 0.5 ng/mL. A calibration curve for formaldehyde was plotted with concentration ranging from 0.05 - 0.5 µg/mL against fluorescence intensity using a spectrofluoro -photometer (Shimadzu RF-5301PC spectrofluorometer, Shimadzu Scientific Instruments Inc., Marylan, U.S.A) at an excitation wavelength of 410 nm and an emission wavelength of 510 nm. The calibration plot is displayed in Figure 1.

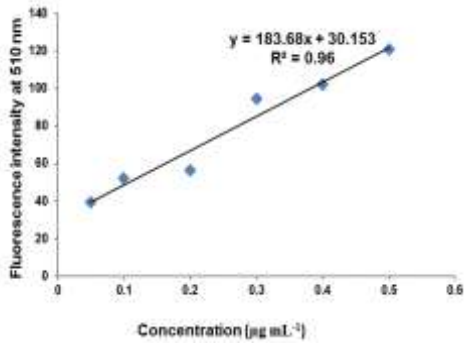

Figure 1. Calibration curve of formaldehyde by Hantzsch reaction

After dialysis of the prepared formaldehyde sample, samples inside (donor compartment) and outside the dialysis membrane (receptor compartment) were tested for formaldehyde content using the Hantzsch method. It was found that formaldehyde was almost completely removed within 24 h. Figure 2 shows the photographs of samples after dialysis. Considering the colour and much lower detection level of the Hantzsch method, it could be concluded that dialysis is an efficient method for removal of residual formaldehyde from aqueous solutions.

Figure 2. Samples inside (A) and outside (B) of the dialysis tube after Hantzsch reaction. Greenish yellow fluorescence indicated the presence of formaldehyde

CONCLUSION

The dialysis method was found to be very effective in the removal of residual solvent. It is anticipated that the method would prove to be very useful in removal of unreacted formaldehyde from aqueous reaction mixtures. The method is expected to be an important step in the purification of drug-DNA adducts.

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